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SOME COMMENTS ON CHLORINE RETENTION AND CHLORINE DAMAGE

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Chlorine damage is due to chlorine retained in the fabric after bleaching; but the amount of damage is not always proportional to the quantity of chlorine retained. At least two other factors are involved: temperature of ironing and buffering power of the resin. In this brief article, the author attempts to show the way in which chlorine damage is influenced by chlorine retention, ironing temperature, and buffering power. The interrelationship between these factors is a complex one, and can at present be expressed only qualitatively.

The effect of chlorine retention and buffering power are best exemplified by data on the cyclic ureas. Particular attention is given to the concept of buffering power, which has hitherto received only casual mention in the literature.

INTRODUCTION

ONE of the well-known disadvantages of nitrogenous resin formers, such as the urea- and melamine-formaldehydes and their derivatives, is the tendency of fabrics containing them to pick up chlorine from hypochlorite bleaching baths and to retain it despite prolonged rinsing. The chlorine, which is held in the form of a chloroamide, $>N-\overset{\overset{O}{\|}}{C}-N-CH_2-$, is

called *retained chlorine,* and the phenomenon is called *chlorine retention.*

At times, retained chlorine will make its presence known by the faint odor of chlorine which persists in the rinsed fabrics. At other times, the fabric will have a yellowish color, acquired during chlorination—this is characteristic of melamine resins. Frequently, however, there is no outward sign until the fabric is hot pressed or ironed. Then, if the conditions are sufficiently drastic, the fabric will become weakened and embrittled. The exact course of the action is not known; presumably the chloroamide is converted to hydrochloric acid, which, when released within the fibers under high temperature, hydrolyzes the cellulose. The resulting loss in tensile strength is called *chlorine damage.*

A more exact name for the strength loss is *damage due to retained chlorine.* This distinguishes it from damage that might occur, for example, during the wet chlorination step. Some authorities have used the term *chlorine-retention damage* (*1*), which might well be adopted generally. However, for present purposes we shall merely speak of chlorine damage, keeping in mind that this refers only to tensile loss on ironing.

DISCUSSION

The main purpose of the present discussion is to show the complex relationship between chlorine retention and chlorine damage. Some persons use the term interchangeably, in the belief that they are synonymous. This is far from true, because there are many other factors that complicate the situation.

The most obvious of the complicating factors is the temperature of ironing. Consider, for example, the data of Table I, from an early study of chlorine retention of resin-treated rayon (*3*).

These fabrics had been heavily chlorinated with a large excess of hypochlorite, as is customary in accelerated laboratory testing. Despite thorough rinsing, all the resin-treated fabrics smelled of chlorine, and the two melamine finishes were quite yellow, especially the unmethylated one. Yet on ironing, no appreciable strength loss was noted until the temperature approached 300°F in the case of the urea resin and 400°F in the case of the melamine resins.

Two conclusions may be drawn. First is the very obvious fact that chlorine retention does not lead to chlorine damage unless the fabric is subjected to a high temperature. That is, chlorine damage is a function of both chlorine retention and ironing temperature; or in pseudo-mathematical terms,

$$\text{Chlorine Damage} = f\,(\text{Chlorine Retention, Ironing Temperature}) \quad \text{(Eq I)}$$

The second conclusion, which has been confirmed by much additional data, is that some resin finishes are less prone to damage than others, even though the chlorine retention (% Cl) and ironing conditions are comparable. Thus, an important variable is missing from the above equation.

There are two possible reasons for the greater resistance to damage of the melamine finish: a) the chlorinated melamine does not decompose as readily, so that little or no hydrochloric acid is produced below 350°F; or b) acid is produced, but is buffered by the melamine, which is more basic than is urea.

TABLE I
Effect of ironing temperature on chlorinated resin-treated rayon

Resin type	Chlorine retention % Cl	Tensile strength after ironing 30 sec at given temp (°F) 200	250	300	350	400
Urea	1.47	50	49	13	2	2
Melamine	1.27	49	50	—	42	11
Methylated melamine	1.27	41	42	—	37	14
Water control	0.05	45	45	—	46	38

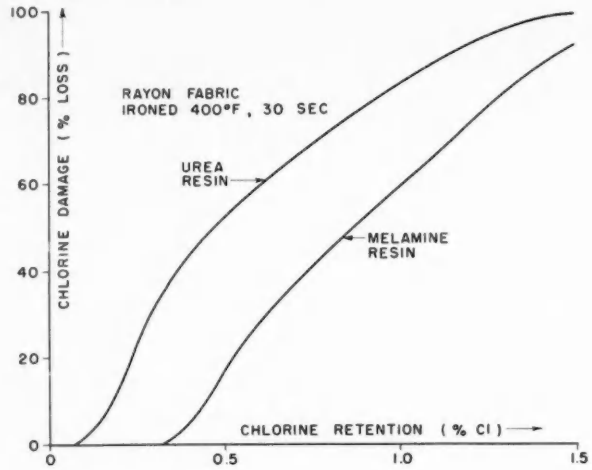


Figure 1
Relationship between chlorine damage and chlorine retention

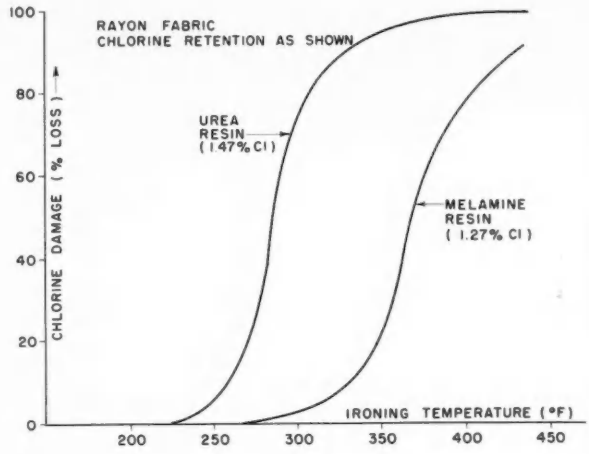


Figure 2
Relationship between chlorine damage and ironing temperature

Probably both of these mechanisms are operative to a degree. The greater stability of the chloro-melamine is shown by its greater resistance to high-temperature rinsing (*3*), as well as by its tendency to liberate chlorine much more slowly on storage. The latter effect can be observed visually if the chloro-resin is converted to the iodo-resin by treatment with potassium iodide solution; the iodo-melamine will retain its brown color much longer than will an iodo-urea. But these phenomena, while they attest to the greater stability of the chloro-melamine, do not necessarily imply that this has an important bearing on the quantity of hydrochloric acid produced during ironing. The importance of this factor cannot be assessed on the basis of present information.

On the other hand, there are several bits of evidence tending to support the alternate hypothesis that buffering power is responsible for the greater resistance to chlorine damage. For example, addition of a melamine resin to a urea-resin finish will in some cases bring about a disproportionate decrease in chlorine damage (*5, 6*). This does not come about through reduction in chlorine retention; in fact, the percentage of chlorine picked up is usually greater. Nor is the chloro-melamine likely to influence the thermal break-down of the chloro-urea. The most logical explanation of the lower degree of damage is that the melamine resin helps to buffer the acid released by the urea resin.

Another phenomenon explainable on the basis of buffering power is the effect of metal salt catalysis. In the case of a mild catalyst, such as magnesium chloride, the chlorine retention (% Cl) is often higher than if, for example, an amine hydrochloride catalyst had been used; yet chlorine damage is lower. Moreover, the fabric almost invariably shows a pronounced white ash when burned. The protective action may be attributed to the presence of a basic residue, such as magnesium oxide or carbonate, which buffers the hydrochloric acid liberated during ironing. Padding with alkali following the resin treatment will enhance the effect, particularly in the case of urea and modified-urea resins, because it precipitates the metal; but repeated laundering will eventually overcome the protective action by washing out the basic residue, and the damage will increase to its normal value.

If for the moment we accept the hypothesis that buffering power of the resin is an important factor, we may then conclude that the chlorine damage will be a function of the chlorine retention, the ironing temperature, and the reciprocal of the buffering power:

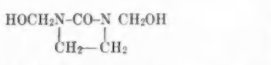
$$\text{Chlorine Damage} = f\left(\frac{\text{Chlorine Retention, Ironing Temperature}}{\text{Buffering Power}}\right) \quad \ldots\ldots \text{(Eq II)}$$

Unfortunately these are not straight-line relationships. For a given resin and specified ironing conditions (so that buffering power and ironing temperature are constant) the curve for chlorine damage as a function of chlorine retention has the typical form shown in Figure 1. For a given resin of specified chlorine content (so that buffering power and chlorine retention are constant) the curve for chlorine damage as a function of ironing temperature has the typical form shown in Figure 2. The above equation is therefore not intended for purposes of calculation, but rather to illustrate a concept.

Buffering power is probably just as complex a variable as the others. Its influence is suggested by the difference in the curves for the urea and melamine resins in Figures 1 and 2. As a further illustration of its importance, let us consider the case of the cyclic urea derivatives.

THE CYCLIC UREAS——Urea formaldehyde, in its normal textile forms, includes paste resins of low F/U content (mixtures of $HOCH_2NHCONH_2$ and $HOCH_2NHCONHCH_2OH$) and liquid resins of higher formaldehyde content, usually methoxymethylated ($(CH_3OCH_2)_2NCONHCH_2OCH_3$). The more formaldehyde, the fewer unblocked amide (>NH) groups will be left to pick up chlorine. However, it is not possible to completely block the amide groups in urea with formaldehyde; such a structure would be relatively unstable.

A better approach to low chlorine retention is to start with ethylene urea, which yields a stable, rather completely blocked dimethylol derivative:



This product, introduced on a commercial scale in 1948, has proved to be much superior to previous urea resins in reactivity, durability, and resistance to chlorine damage. The latter property is achieved by virtue of the fact that the blocked, stable structure picks up very little chlorine.

TABLE II
Effect of resin type on chlorine retention and damage*

Resin type	Resin concentration on rayon fabric: 5% Solids — Percent Cl	5% Solids — Tensile after 400° ironing	10% Solids — Percent Cl	10% Solids — Tensile after 400° ironing
Urea	1.19	2	1.74	2
Melamine	2.44	2	2.77	2
Methylated melamine	1.55	2	1.85	2
Ethylene urea	0.25	46	0.33	43

* Large excess of hypochlorite used to emphasize the effect (0.40%, 30 : 1 bath ratio, 10 min at 140° F)

TABLE III
Effect of washing and chlorinating variables

Washing conditions	Available chlorine on total bath (%)	Chlorine retention (% Cl)	Chlorine damage (% loss)*
Not washed	0.25	0.06	0
pH 10.9 10 min/140° F	0.25	0.11	25
pH 10.9 40 min/200° F	0.25	0.22	74
pH 10.9 10 min/200° F	0.001	0.05	0
" "	0.01	0.09	8
" "	0.10	0.14	58
" "	1.0	0.25	88

* Chlorination followed AATCC 69-1952 except for varied concentrations. Ironing was at 365° F for 30 seconds

Theoretically, it should pick up no chlorine at all, but a slight degree of unblocking may occur during the application of the product to the fabric. In a properly cured fabric, chlorine retention is low, therefore damage is low. This is illustrated by the data in Table II, from a published source (*3*).

Unfortunately, buffering power of ethylene urea is no higher than that of the urea from which it is derived. Therefore, any influence that "loosens-up" the finish and so raises the chlorine retention to a critical level, will greatly increase the chlorine damage. This is particularly true on cotton, which has less resistance to acid damage than does rayon (*4*). In fact, under certain circumstances a cotton fabric will show noticeable damage from as little as 0.1% retained chlorine.

Two of the most common influences on the amount of chlorine retained by the finished fabric are hot alkaline washing prior to chlorination and high concentration of chlorine in the bleach bath. When a hot alkaline wash is followed by a severe chlorination, as in the AATCC Tentative Test Method 69-1952, "Damage Caused by Retained Chlorine" (*7*), chlorine retention can become high enough to cause severe damage in the ironing step.

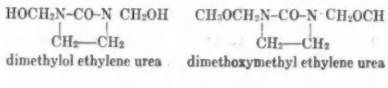
Data in Table III show the effect of these factors. The fabric was an 80x80 cotton treated with dimethylol ethylene urea and an amine hydrochloride catalyst. In one case the fabric was washed in several ways before chlorination at a high (0.25%) level of hypochlorite. In the other, the fabric was given a 200° scour in 0.1% Na_2CO_3 (pH 10.9), then subjected to several levels of chlorine.

It is interesting to note that, despite the varied means employed to alter the chlorine retention, all the data fall along the same curve when chlorine damage is plotted against chlorine retention. This is as it should be, since ironing temperature and buffering power of the resin are constant throughout.

Another process that can increase chlorine retention, and therefore chlorine damage, is the acid souring encountered in the usual commercial laundering procedure. The sour is a final operation, so that its influence does not become apparent until the fabric is chlorinated during a subsequent wash. The number of launderings the fabric will withstand before strength loss becomes noticeable will depend on the acidity of the sour, the alkalinity and temperature of the wash, the concentration of hypochlorite, and the conditions of hot pressing.

Considering that either acid or alkaline hydrolysis will increase chlorine retention, it is probable that a variety of mechanisms are responsible: for example, a) hydrolysis of "dangling" methylol groups which had not reacted with the cellulose; b) hydrolysis of oxymethylene linkages between the ethylene urea and the cellulose; and c) opening of the ethylene urea ring, probably through loss of the carbonyl (>C=O) group. Any of these actions would lead to additional >NH positions on which chlorine could be picked up.

The importance of "dangling" methylol groups is suggested by a comparison of dimethylol ethyleneurea and its dimethyl ether:



dimethylol ethylene urea — dimethoxymethyl ethylene urea

Applied to cellulosic fabric, these should crosslink the cellulose in the same manner and so give identical results. However, comparison (at 10% solids on rayon fabric) shows the methyl ether to retain less chlorine when subjected to alkaline washing and severe chlorination (refer to Table IV). The most logical explanation is that reaction with the cellulose was not complete in either case, and since the unreacted ("dangling") methoxymethyl groups are more resistant to hydrolysis than are the unreacted methylol groups, fewer >NH sites were made available for chlorine pickup.

It will be noted, however, that both compounds showed the same chlorine damage at a given level of chlorine retention, as would be expected since their buffering power is identical.

TABLE IV
Resistance to hydrolysis of unreacted end groups

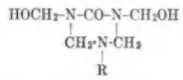
Resin solids	Number of washes*	Chlorine retention % Cl	Chlorine damage % loss**
10% Dimethylol EU	0	0.29	8
	1	0.35	4
	3	0.40	37
	5	0.47	74
10% Dimethoxymethyl EU	0	0.17	0
	1	0.20	0
	3	0.35	8
	5	0.40	37

*Full Sanf wash, 0.1% Ivory soap
**Chlorination 0.40% available Cl, 10 min 140° F; ironing 30 sec at 400° F

It should not be concluded from the foregoing that an ethylene urea finish is easily degraded. On the contrary, it is among the most durable of finishes if judged by maintenance of crease recovery or similar property. The difficulty arises because chlorine retention will reach the critical level when only a small proportion of new >NH groups have been formed.

Let us turn now to another type of cyclic urea—the triazone. The first of these became commercially available in 1953, and by 1956 there were several varieties on the market; but only during the past year have they enjoyed any appreciable usage.

The triazone, more formally known as 1,3-dimethylol 5-alkyl perhydrotriazone-2, is similar to ethylene urea but contains an amino-nitrogen in the ring:



This structure, like that of the ethylene urea product, is represented as having the nitrogens completely blocked. Therefore it should not pick up chlorine. Actually, however, some free >NH groups may be present in the original product, or may be formed

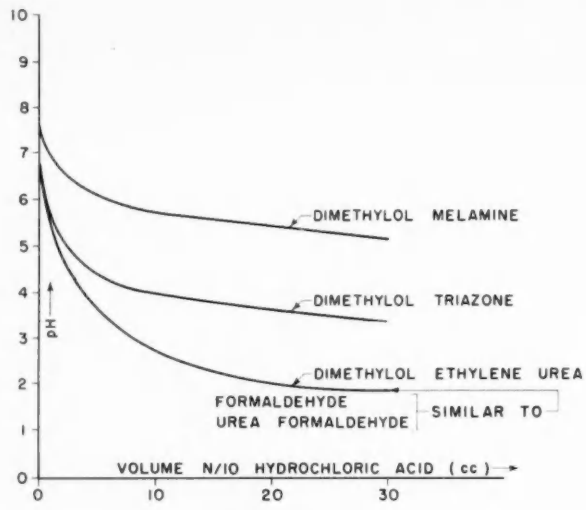


Figure 3
Representative titration curves for various resins and reactants

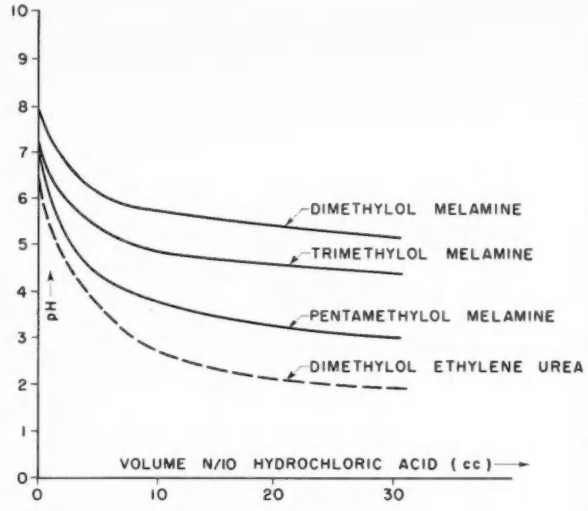


Figure 4
Titration curves for melamine resins of varied formaldehyde ratios

during the cure. In any event, the triazone will retain some chlorine, and, in fact, will usually retain more than will ethylene urea under similar circumstances.

However, when cotton fabrics treated with the two products are chlorinated and ironed, an important distinction shows up: whereas the ethylene urea finish will damage severely at, say, 0.15% retained chlorine and 365° ironing (30 seconds), the triazone will not. In terms of Equation II, we can state that chlorine damage is different for the two products, despite the fact that retained chlorine and ironing temperature are equivalent. Therefore buffering power must be different. This difference in chlorine damage at equivalent chlorine retention is illustrated in Table V. The data relate to cotton fabrics treated with either six percent solids of an ethylene urea formaldehyde product or seven percent solids of a triazone, plus one percent amine hydrochloride in each case. Washing was conducted at 200°F for 40 minutes followed by rinsing. Ivory soap plus sodium tetraphosphate to pH 9.6 were used in one wash; the other employed a synthetic detergent plus 0.5% sodium carbonate (pH 11.2).

The difference due to buffering power between the ethylene urea and triazone types is similar, in principle, to that shown earlier by urea-formaldehyde and melamine-formaldehyde resins. However, in the case of the cyclic ureas, chlorine retention is much lower than was the case with the older products. Thus the triazone exhibits low chlorine damage for two reasons—chlorine retention is rather low, and buffering power is high.

TABLE V
Chlorine damage vs chlorine retention, ethylene urea vs triazone

Treatment	After-wash*	Chlorine retention % Cl	Chlorine damage** % loss
Untreated control	none	0.01	0
	pH 9.6	0.01	0
	pH 11.2	0.03	0
Dimethylol ethylene urea	none	0.04	3
	pH 9.6	0.05	8
	pH 11.2	0.10	69
Dimethylol triazone	none	0.13	9
	pH 9.6	0.18	11
	pH 11.2	0.26	7

*Tumble-washed 40 minutes at 200° F, followed by rinsing
**AATCC 69–1952

Ethylene urea, with its low buffering power, shows low chlorine damage only because of its low chlorine retention.

Another, and very simple way of demonstrating the higher buffering power of the triazone is by means of an ordinary titration procedure. Fifty cubic centimeters of a 10% (solids) solution of each resin are titrated with N/10 HCl. Data for pH versus cc HCl are then plotted as shown in Figure 3. Dimethylol ethylene urea, urea formaldehyde and formaldehyde give almost identical plots. The dimethylol triazones give a curve that levels off at a higher pH, thus indicating their ability to buffer the hydrochloric acid. A typical dimethylol melamine resin gives a still higher curve, as shown.

It is doubtful whether any quantitative information can be derived from the curves. A series of melamine products differing in formaldehyde content will give different curves, as shown in Figure 4. This suggests that the exact buffering power will be a function of the extent to which the basic melamine group is substituted. If this is so, then the buffering power of the cured resin on fabric may be quite different from the buffering power in solution.

Nevertheless the curves have considerable value in illustrating qualitatively the concept of buffering power as applied to textile resins. Moreover, such curves have been used in this laboratory since 1954 to help distinguish ethylene urea products from more basic cyclic ureas.

Attempts to obtain a more realistic measure of buffering power by titrating cured fabrics have not been very successful. There is, however, another way of showing a difference between ethylene ureas, triazones, and melamines, based on dye pickup. If cotton fabrics containing the three types of products are dyed with 0.1% bromphenol blue, buffered to pH 4, for five minutes at 140°F, followed by rinsing, the melamine will stain deeply, while the others will stain more lightly. Similarly, treatment with 0.2% picric acid, two minutes at room temperature, will color both the melamine and the triazone. These results are listed in Table VI.

Here again no quantitative inferences can be drawn. By this test a variety of melamine products give equivalent dyeings regardless of formaldehyde ratio, suggesting that the wide differences in titration values of the materials in solution (Figure 4) do not necessarily hold for the cured resins. However, we must remember that other factors besides basicity can influence dye pick up. Accordingly, considerable caution

should be taken in drawing conclusions from such tests.

PRACTICAL IMPLICATIONS

Millions of yards of fabrics have been processed with ethylene urea formaldehyde to obtain creaseproofing, wash-wear, or durable glazing or embossing. Durability to household washing, with or without chlorine bleach, has been very good. Moreover, complaints of chlorine damage have been negligible. This is no doubt due to the fact that mild chlorination, even though preceded by washing, does not produce a very high level of chlorine retention. Also, ironing temperature may be low, or at least of short duration. Therefore damage is low.

While it is too early to make broad statements concerning all triazones, it can be said that, as a rule, the triazone finish is less durable to repeated mild chlorinations than is the ethylene urea finish. This will show up, for example, as a drop in crease recovery. This, plus the fact that household chlorinations do not produce chlorine damage in ethylene urea finishes, makes it difficult to find any advantage for the triazone in such an application.

There are, however, two situations where ethylene urea formaldehyde shows to disadvantage. The first of these involves multiple commercial launderings, particularly if more than the recommended 0.01% available chlorine is used. As a result of the high alkalinity of the washes and the acidity of the final souring operation, the finish may "loosen up", so that chlorine retention and chlorine damage may eventually become evident. The second situation involves accelerated laboratory testing: one or more severe washes followed by an accelerated chlorination, such as the AATCC Tentative Test 69-1952. The advantage of the triazone under such conditions was illustrated in Table V.

Wash-wear finishes on white cotton goods are presumably intended for household laundering. Yet there is always the possibility that the garments may be sent to a commercial laundry. In such a case, the triazone gives a greater margin of safety. It will not damage, even where the bleaching conditions are considerably in excess of those recommended by the American Institute of Laundering. After a few such launderings, the triazone finish may have been washed out, but at least no chlorine damage will have appeared. On this basis alone, the triazones seem destined to find considerable use in the white wash-wear field (*2*).

TABLE VI
Effect of acid dyes on various resin treatments

Resin type	*Bromphenol blue*	*Picric acid*
Ethylene urea	light gray-blue	pale yellow
Triazone	med gray-blue	deep yellow
Melamine	deep gray-blue	deep yellow

Competition in this field may come from three sources:

a) Nonnitrogenous reactants such as the acetals and the diepoxides. These cannot retain chlorine, and therefore show no chlorine damage. However, they usually lack sufficient crease recovery, especially from the standpoint of springy feel.

b) Mixtures of nonnitrogenous reactants with nitrogenous materials, as for example a diepoxide plus dimethylol ethylene urea (*2*). These have somewhat greater resilience. Such mixtures, properly applied, maintain their low chlorine pickup despite repeated washing. Accordingly, they show little damage.

c) Mixtures of melamines, for increased buffering power, with other materials—either nitrogenous or nonnitrogenous—that will not only reduce the chlorine pickup, but also the tendency of the melamines to yellow on chlorination.

In the latter connection, it is interesting to note that the triazones provide buffering power without any tendency to yellow on chlorination. On the other hand, they tend to yellow on ironing—this is a discoloration rather than a scorching. They also show a pronounced tendency to produce fish odor. Both of these drawbacks can be minimized by a good afterwash; but it is too early to say whether either or both troubles will reappear when triazone-finished fabrics are routinely processed on a large scale and subjected to the vagaries of end use.

One other development is worth further comment: use of metal salt catalysts. These are by no means new, but wide-spread interest began only a few years ago with the use of magnesium chloride with melamines to minimize yellowing and reduce chlorine damage. The mechanism of the reduction in yellowing is not clearly understood. Unfortunately the advantage is obtained only on low temperature chlorination; yellowing shows up when the fabric is chlorinated at 140°F or above. The reduction in chlorine damage is primarily the result of increased buffering power, due to magnesium oxide or carbonate left in the fabric. Actual chlorine retention is usually as high, and in some cases even higher, than when nonmetallic catalysts are used.

On the other hand, some metal salt catalysts give a very "tight" cure, especially when applied at high temperature. For example, the use of zinc nitrate with dimethylol ethylene urea is particularly effective from the standpoint of chlorine damage (*1*). In such cases the metal salt catalyst and high-temperature cure encourage the reaction of the resin with the cellulose, and chlorine pickup is low. In addition, the buffering power is increased by the basic zinc residue. Such a finish is effective in resisting household chlorinations, but will not withstand repeated commercial laundering.

SUMMARY

It has been shown that chlorine retention and chlorine damage are not synonymous. Chlorine damage is dependent on at least three factors: chlorine retention, ironing temperature, and buffering power of the resin (or of other components of the finish). The interrelationship between these factors is quite complex, but even a qualitative knowledge of the subject can lead to a better understanding of the behavior of finishing agents in end use.

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(*5*) US Patent 2,690,404 (Spangler and Wayland to Dan River Mills, 1954).
(*6*) US Patent 2,833,674 (Hurwitz to Rohm and Haas Co, 1958).
(*7*) *Technical Manual and Year Book of the American Association of Textile Chemists and Colorists* **XXXIII**, 121 (1957).

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• PATENT DIGEST •

PAUL WENGRAF

HYDROPHOBING OF TEXTILES ——Aluminum alcoholates reacted with monobasic acids and waxes G,2,02

USPat 2,801,190 (Farbwerke Hoechst —— Orthner, Reuter —— July 30, 1957)

The preamble to this specification reports on various methods of preparing aluminum alcoholates. According to US Pat 2,469,041 / 1949 (see references below) reaction products of aluminum alcoholates with carboxylic acids, *which result in neutral aluminum salts*, have been applied in solvent solutions and used for rendering textiles water repellent. However, the hydrophobic effect obtained in this procss reportedly is insufficient.

It has been found that good water-repellent effects may be obtained by treating textiles in organic solvents containing reaction products of a) one mol aluminum alcoholate, b) about 0.2-0.5 mols of monobasic organic substances of acid nature, and c) higher molecular paraffin hydrocarbons, waxes or high-molecular-weight polychlorinated hydrocarbons. Thus no neutral salts as described in US Pat 2,469,041 are applied. The reaction starts in the cold and is completed by heating.

a) Aluminum alcoholates include, for instance, methylates, ethylates, etc. They may also contain halogen, thus corresponding to the formula Al-hal- $(OR)_2$. In halogenated alcoholates of this type, part of the radicals bound by ether linkage can be split off, probably forming bridges between the aluminum atoms; this reaction is believed to be essential for the final effect (col 3, lines 25-27).

b) Monobasic organic substances of an acid nature include monocarboxylic or monosulfuric acids or esters thereof; also anhydrides, diacyl amides, etc, provided that they are capable of reacting with the aluminum alcoholates mentioned. *Mixtures* of acid nature are patricularly valuable: one of the acid components of the mixture may react after the other; eg, first acetic acid, then stearic acid.

c) Various kinds of solid paraffin, Carnauba wax, Ceresin, also chlorinated hydrocarbons are enumerated. They are dissolved in benzene or chlorinated hydrocarbons for use in the impregnating of textiles.

Example: Cotton poplin is impregnated for five to 10 minutes at 60°C in a scouring machine, suitable for drycleaning, with a solution of a condensate of aluminum isopropylate and 0.55 mols stearic acid in carbon tetrachloride and the same amount of paraffin. The solvent is then distilled off, the fabric is air-dried and finished by ironing. 56 other examples, covering various textile materials, the components and the solvents, are presented.

Among the references cited by the Patent Office:

US Pat 2,345,142 (Muller/1944) discusses water-repellent emulsions which are comprised of an Al, Zr or other metal salt in the continuous (aqueous) phase in the absence of a protective colloid.

US Pat 2,469,041 (Standard Vacuum Oil Co/1949) cover the preparation of a solution of aluminum alkoxide, in which a higher fatty acid is added to obtain an Al soap in a hydrocarbon solvent for manufacturing greases and, optionally, for obtaining water-repellent agents.

Brit Pat 657.815 (Nopco Chem Co /1951): metallic soaps, specifically for hydrophobing textiles, are obtained by reacting water-soluble salts of Al, Pb, Ca or Zn with alkaline soaps prepared from hydrogenated castor oil.

HYDROPHOBING OF TEXTILES —— Methylolmelamine impregnation followed by organosilicone treatment G,2,02

USPat 2,802,754 (General Electric Co —— Ashby, Hoffman —— Aug 13, 1957)

It has been disclosed in US Pat 2,612,482 (see references below) that textiles can be rendered water repellent by impregnations with combinations of amino resins (urea or melamine condensates) and organopolysiloxanes, the latter comprising mixtures of methylpolysiloxanes and methyl hydrogen polysiloxanes. Effects obtained by this method are generally good but do not resist repeated launderings.

Unexpectedly, a more durable water repellency could be attained by applying a similar procedure *in two separate steps*, by first treating with a specific melamine condensate, curing, then treating with an emulsion of the above-mentioned polysiloxane combination, and finally curing again. It has been observed further that *fusible soluble methylether derivatives of trimethylolmelamine only* must be applied in the first step, because other urea- or melamine-aldehyde condensates (as mentioned in US Pat 2,612,482) do not give adequate results.

Mixtures of alkylhydrogen polysiloxanes and alkyl polysiloxanes are prepared according to known methods by the cohydrolyzing of alkyl chlorosilanes.

The superiority of the two-step process over the older one-step process is cited in the following example. A five percent aqueous solution of trimethylated trimethylolmelamine (M-3 resin, Am Cyanamid Co) containing one percent of 2 methyl-2-amino-1-hydroxypropane hydrochloride as a catalyst was padded on a cotton fabric, which was then dried and cured for five minutes at 110°C. Thereafter the fabric was passed through an emulsion of the above-mentioned polysiloxane mixture and heated again for five minutes to 110° C, then to 150° C for another five minutes. A control sample was prepared according to the one-step procedure by curing first at 110° C, then at 150° C. Both treatments resulted in a spray rating of 100 according to the procedure in the *AATCC Yearbook* 22, 229-33 (1945). The samples obtained in the two-step method showed a slowly decreasing spray rating down to 70 in four washing cycles, while the spray-rating of the one-step control sample dropped to zero after the third washing operation.

Among the references cited by the Patent Office:

US Pat 2,612,482 (Gen Electric/ 1952) covers a water-repellent finish consisting of a water-soluble condensate of the urea- or melamine-formaldehyde class, blended with emulsified mixtures of methyl hydrogen polysiloxanes and organopolysiloxanes, free of Si-bonded hydrogen [cf *Am Dyestuff Reptr* 42, 31 (1953)]

US Pat 2,386,259 (Gen Electr/ 1945): hydrophobing with the oily product obtained by hydrolysis of a methyl dihalogeno silane.

Abstracts

Arresting the Decline of Cotton

Anon, *Fibres (Eng & Chem)* **19**, 154, May, 1958

Under the impact of the new synthetic fibers, cotton is fighting a losing battle in many industrial fields where textiles are a necessity. For heat-resistance, electrical insulation, and rot-proof qualities it cannot compete with many of the man-made fibers.

But cotton treated by the process known as *acetylation* is given a new life with all these qualities greatly enhanced.

The acetylation process has been carried on in England for nearly 30 years by Cotopa Ltd. The chemical constitution of the cotton is altered without affecting its fibrous form. A very important feature of the process is that the handle and appearance of acetylated cotton are almost identical with these qualities in the cotton before treatment, but with some increase in volume and weight.

The heat resistance of acetylated cotton is outstanding. Under the influence of heat it has from four to six times the life of untreated cotton and is superior in this respect to most synthetic fibers, according to the author. It also withstands steam heat, does not soften, and does not build up static like the synthetics. It is also immune to bacteriological attack.

The treated cotton resists dyeing with direct dyes, but may be dyed with disperse colors.

Acetylated cotton, due to its heat resistance, is used in conveyor belts, steam hose, and vulcanized driving belts. The yarn is employed as an insulant for telephone switchboard wires and cables. Its immunity to microbes makes it of interest to the fishing industry.

Acetylated cotton (yarn and cloth) is sold under the trade names Cotopa, Crestine and Crestose.

The Coloring of Vinylon

Nomura, S and Tanabe, K, *J Soc Dyers Col* **74**, 359-70, May, 1958

Vinylon is usually made by spinning an aqueous solution of polyvinyl alcohol, heat-treating the water-soluble fibers obtained, and subsequently acetalizing with formaldehyde. As both hydroxyl and acetal groups in the accessible region are concerned in the dyeing of Vinylon, it is generally intermediate in dyeing behavior between cellulosic fibers and typical synthetic fibers. The dyeing properties of Vinylon with direct dyes are thus affected not only by crystallization due to heat-treatment and degree of acetalization but also by the acetalizing conditions.

For the practical dyeing of Vinylon to medium or heavy depths, direct, sulfur, vat, azoic, disperse and metal-complex dyes may be employed, and their fastness is not greatly different from that on other fibers. Deep colors, however, can be obtained on Vinylon with satisfactory brightness and fastness only with a limited number of groups of dyes. Dope dyeing is now most advantageous for blacks and dark blues, and is carried out on a commercial scale. Since Vinylon contains no basic nitrogen, it cannot be dyed with acid wool dyes.

The process of manufacture of Vinylon is described in much detail, and a table of its most important physical properties is included.

The fiber may be scoured in the same manner as any of the usual man-made fibers. For medium and heavy shades it requires no bleaching. For pale shades, however, it is bleached with sodium hypochlorite or sodium chlorite. For Vinylon/wool blends, peroxide may be used.

The dyeability of Vinylon with direct dyes varies widely from dye to dye. Those dyes which contain many sulfonic acid groups generally have poor substantivity. Sulfur dyes also show a wide variation in substantivity. Vat dyes are used mostly for pale to medium shades. Azoic dyes, applied by the method used on cellulosics, give unsatisfactory results, but yield good effects when applied by the method employed on acetate. Disperse dyes are absorbed fairly well, but have poor fastness. Metal-complex dyes of the 2:1 class produce at least medium depths of excellent fastness.

The dyeing of blends with cellulose fibers, and dope dyeing, are also described.

Fourteen references to the literature are cited.

The Dyeing of Nylon with Acid and Mordant Dyes at High Temperatures

Hadfield, H R and Seaman, H, *J Soc Dyers Col* **74**, 392-9, May, 1958

Studies of the effect of temperatures above 100°C on the application of acid dyes to wool have shown a large improvement in level dyeing. Although it has been generally assumed that a similar improvement is obtained on nylon, no quantitative results have been available. The detailed work described in this paper was designed to obtain these results, and also to determine the effect of high-temperature dyeing on the covering of nylon yarns of different dyeing properties. Micro-dull continuous filament nylon yarn was used in this investigation.

A study was made of the stability of acid and chrome dyes in solution at temperatures above 100°C. The effects of an increase in dyeing temperature above 100°C on the leveling of acid dyes and on the rate of chroming of chrome dyes were also determined.

The leveling tests were conducted at 95°, 110° and 130°C by dyeing two skeins in each dyebath for 45 minutes, then removing one skein and replacing it with an undyed skein, and continuing the dyeing for 45 minutes longer.

The stability of acid dyes at high temperatures was determined by making two sets of dyeings, one at 95°C and the other at 130°C. Of the 113 dyes tested, 87 were found to be suitable for dyeing at 130°, while the remaining 26 were considered unsatisfactory because of shade changes, which are listed in a table.

It was found that, with practically all the dyes tested, maximum leveling at 95-130° was obtained with a dyebath exhaustion in the range of 80-90 percent. Increasing the exhaustion decreased the levelness. The dyeings made at 110° and 130°C showed improved levelness, compared with 95°.

The stability of chrome dyes at high temperatures was determined by heating solutions for one hour at 100°, 120° and 130°C, and by making dyeings at 95° and 130°C. Of the 34 dyes tested, 23 were found suitable for application at either 95° or 130°, nine were not suitable at 130°, while two were suitable at 130° but not at 95°.

Chroming of three typical chrome dyes at 130°C was found to give complete metallization in 10 minutes, compared with one hour when chroming at 95°.

The effect of raising the dyeing temperature from 95° to 130°C on the covering of irregularly dyeing nylon yarns was determined by means of five acid dyes. In every case an improvement in the coverage of physical irregularities in the yarns resulted from dyeing at 130°.

The authors state that the results of these tests emphasize the importance of controlling the exhaustion of the dyebath during the dyeing of

nylon, and confirm the rapid rate of chroming above 100°C.

Twelve references to the literature are cited.

Dyeing Fabrics Containing Metallic Yarns

Thomas, R J, Papers of AATT, *Modern Textiles* **38**, 65-6, June, 1957

In the past, the dyer confronted with the task of dyeing fabrics containing metallics has been concerned with the possibilities of delamination, dulling, discoloration and staining of these effect yarns. Within the past two years, metallic yarns made with Mylar polyester film have been introduced to the trade. The manufacturers of these yarns claimed outstanding advantages over the earlier metallics, including their ability to withstand higher processing temperatures and resist chemical attack and their substantially lower affinity for the dyes applied to the ground fibers.

These factors were considered in an evaluation survey of many of the metallic yarns which were commercially available in 1956. It is concluded that the dyer must still be concerned with the four problems of delamination, dulling, discoloration and staining of the metallic effect yarns, but he does have greater operational freedom than was heretofore possible.

Although aluminum is attacked by acids and alkalis, the adhesive used in bonding aluminum to Mylar has a protective action, so that many of the metallic yarns can be subjected to a number of processing and dyeing operations without delamination and without losing color. Mylar resists many acids and most alkalis; it also resists dye absorption and is heat-stable.

The author states that goods containing metallic yarns should not be kier-boiled, but may be mercerized without undue dulling of the aluminum. The yarns are not affected by a chlorine bleach. In peroxide bleaching, the use of a nonsilicate method is less likely to cause dulling and discoloration than the highly alkaline silicate process.

Goods containing metallic yarns made with Mylar can be dyed with vats by the continuous pad-steam process without damage.

In dyeing with direct dyes, diazotization and development does not affect the metallic yarns, and after-treatment with a U-F resin, followed by baking at 315°F, had no visible effect.

When wool fabrics containing metallic yarns are dyed with acid dyes in a sulfuric acid bath, some of the yarns are dulled; others are not.

If nylon, Dacron or acetate containing Mylar metallic yarns are dyed with disperse dyes, the yarns are usually stained, the degree of staining varying with the different dyes of this class.

The author warns that, since the metallic yarns currently available are made by different firms, the adhesives and laminating techniques employed may not all be equally effective.

How Direct Colors Dye Cellulosic Fibers

Boulton, J, *Textile World* **108**, 96-7, June, 1958

The first systematic research into cellulose dyeing was associated with viscose rayon. The early production of rayon showed various degrees of dyeability, particularly with certain direct dyes.

It became apparent to early researchers that dyes that migrated well within the fiber and gave good exhaustion at low temperatures produced even dyeings. Dyes that required high temperatures for exhaustion often produced unlevel dyeings.

This empirical work was followed by more serious research into the structure of the cellulose molecule and the relation between cellulose structure and the shape of the dye molecules.

Cellulose, like other textile fibers, is made of polymeric chains, linked by cellobiose units. The chains are packed together to form filaments. Closely packed areas are crystalline in nature. Where there is less compaction, the fiber is amorphous.

When a filament is wetted, water is absorbed in the amorphous areas, which are pushed aside by the water to form pores in the fiber structure. These pores form channels along which the dye molecules make their way during the dyeing process, entering and traversing the water-filled channels by a process of diffusion.

Solutions of direct dyes consist of a mixture of large and small bundles of dye-molecule aggregates dispersed in the solution. The molecules tend to aggregate together into tiny dispersed particles in which the sodium cations surround the dye anions; and if salt is present, the particle is surrounded by a layer of chloride anions. These bundles of dye-sodium-chloride aggregate vary in size and form a colloidal electrolyte complex.

Viscose rayon carries a negative charge on its surface, and so does the dye anion. It is obvious that, in order to get the dye into the fiber, the repulsion between like charges must be reduced; and this is accomplished by the electrolyte, salt, present in the solution.

But salt affects the state of solution of the dye as well as its attraction for the fiber. This double effect is very important, because in the first case salt initiates the dyeing process, but if it is present in too great amounts early in the dyeing, salt causes the dye to form large aggregates at the fiber surface before diffusion into the fiber is complete. The result is unlevel dyeing.

In an ideal solution, the small aggregates enter the fiber and diffuse uniformly along the channels provided by the absorbed water. As the small aggregates leave the solution, the larger ones break up to maintain a dynamic equilibrium. The dye molecules enter and become attached to the internal fiber structure. This attachment is responsible for the actual dyeing and exhaustion of the bath.

Diffusion of the dye into the fiber is accelerated when the temperature is raised, and high temperatures promote levelness in the dyeing. Agitation of the bath also promotes faster adsorption of color.

This diffusion-adsorption theory of dyeing with direct dyes has been the subject of much work by many scientists. The author refers briefly to some of these researches.

General Calendar

AMERICAN OIL CHEMISTS SOCIETY
July 14-18 (Short course on soaps and synthetic detergents, Princeton Inn, Princeton, NJ); Oct 20-22 (Sherman Hotel, Chicago); April 20-22, 1959 (Roosevelt Hotel, New Orleans, La; Sept 28-30, 1959 (Statler Hotel, Los Angeles, Calif)

AMERICAN SOCIETY FOR TESTING MATERIALS (COMMITTEE D-13)
Oct 14-17 (Sheraton McAlpin Hotel, New York, N Y)

DIVISION OF CLOTHING AND TEXTILES IN EXTENSION, TEACHING AND RESEARCH, UNIVERSITY OF GEORGIA
Nov 7-8 (2nd Textile Seminar, Georgia Center for Continuing Education, Athens, Ga)

DRUG, CHEMICAL & ALLIED TRADES SECTION, NYBT
Sept 11-14 (Annual meeting, Sagamore Hotel, Bolton Landing, Lk George, NY)

THE FIBER SOCIETY
Sept 9-10 (Montreal, Que); April 29-30, 1959 (Fontana Village, NC)

INSTITUTE OF TEXTILE SCIENCE
Sept 8 (Sixth Scientific Session, McGill Univ, Montreal, Que)

INTERNATIONAL TEXTILE MACHINERY EXHIBITION
Oct 15-25 (Belle Vue, Manchester, England)

MASSACHUSETTS INSTITUTE OF TECHNOLOGY
August 25-29 (Summer course in "The Mechanics of Textile Structures")

NATIONAL COTTON COUNCIL OF AMERICA
Oct 1-2 (Chemical Finishing Conference, Washington, DC)

SOUTHERN TEXTILE EXPOSITION
Oct 6-10 (Greenville, SC)

SYNTHETIC ORGANIC CHEMICAL MANUFACTURERS ASSOCIATION OF THE UNITED STATES
Luncheon meetings at the Hotel Roosevelt, New York, NY: Sept 9, Oct 8, Nov 12

Proceedings of the

American Association of Textile Chemists and Colorists

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July 14, 1958

36th Annual Convention———

DISPOSAL OF COMBINED TEXTILE FINISHING WASTES AND DOMESTIC SEWAGE*

GEORGE G BOGREN
Weston & Sampson
Boston, Mass

Cotton finishing wastes vary widely in character, often over very short periods. For this reason, treatment by chemical coagulation or precipitation requires close chemical supervision which is not available. Biological treatment, with admixture of some domestic sewage to provide bacterial nutrients and seeding, will reduce the BOD 50% to 60% on the average with raw waste pH over 10.5, based on the first five years' results of operation of a high-rate trickling filter. Neutralization of caustic alkalinity makes possible BOD reductions of 60% to 80%.

The wastes treatment plant built in 1952 consists of primary subsiding basins providing an average detention of six hours, flow equalization basins and pumps, one-quarter acre of high-rate trickling filters, pumps capable of providing a 2 : 1 recirculation ratio, secondary subsiding basins providing two-hour detention with 2 : 1 recirculation.

A standard-rate trickling filter, one-quarter acre in area, built in 1923, continues in service.

The wastes treatment plant at Saylesville is about five hours' stream flow from tidewater. Tests indicate that Saylesville cotton-finishing wastes develop initial BOD slowly, the one-day demand being 1/10 that of domestic sewage. These two facts indicate that the five-day BOD is an unfairly severe criterion of the plant's pollution-abatement ability; the slow initial BOD development explains the lower BOD reduction in trickling filters than in the case of domestic sewage.

GENERAL

THIS title permits so broad a coverage of the field that the writer deemed it advisable to limit the scope to cotton finishing, and the specific operational data to one illustrative treatment plant. Furthermore, even the term "cotton-finishing wastes" is not specific enough, as the wastes vary widely in character. Hence, it cannot be decided whether chemical or biological treatment of cotton finishing wastes are preferable without typical analyses of the wastes, nor without pilot-plant experiments.

The literature of wastes treatment contains the results of many investigations into the subject of this paper, which will not be repeated here. The writer would, however, like to mention, at the outset, several basic general deductions.

1) Chemical coagulation is generally conceded to offer high BOD removal, but at a higher cost than biological treatment. What is not generally stressed, however, is the fact that chemical coagulation is impracticable where the character of the wastes varies from hour to hour, or oftener, due to intermittent or periodical discharge of wastes from various finishing processes—at least with present commonly available coagulants. The skilled technical supervision required for continual readjustment of chemical dosages is seldom available.

2) Laboratory pilot-plant studies conducted at rates of flow low enough to be supplied by daily catch samples of raw wastes in small lots are not typical of full-size treatment, since they do not duplicate the hourly, or more frequent, changes in character of raw wastes. They also provide an aging or storage of the raw wastes which is not typical of full-size treatment, and which may be beneficial to the treatment process being studied.

3) Simple neutralization of raw wastes is one form of chemical treatment which can be automatically controlled to meet changes in character of raw wastes, and which is beneficial to biological treatment of wastes. Automatic control of pH as a part of chemical coagulation is possible, and definitely necessary with commonly available coagulants.

4) The type and degree of wastes treatment should be based on the use and planned condition of the receiving water. Treatment for treatment's sake alone cannot be justified, economically.

5) Biological treatment of cotton finishing wastes is possible at high pH, but the efficiency of BOD removal is increased by neutralization. Admixture of domestic sewage increases the efficiency of biological treatment of cotton-finishing wastes ———lacking this, nutrients for biological growths should be provided by addition of nitrogen and phosphorus compounds.

HISTORY OF BIOLOGICAL TREATMENT AT THE SAYLES FINISHING PLANTS, INC, SAYLESVILLE, RI

Figure 1, a location plan, shows where the Saylesville treatment plant is located in relation to municipal sewage treatment plants.

In 1920, primary subsiding basins and sludge beds were constructed to handle the average daily flow of 2.0 million gallons per day (mgd).

In 1923, complete treatment for part of the wastes was provided by the construction of 0.25 acre of standard-rate trickling filter and 1.0 acre of intermittent cinder filter, designed to handle 0.3 to 0.5 mgd (*1*).

In 1952, after pilot-plant studies

*Presented on November 14, 1957 as part of the Textile Waste Disposal Symposium held during the 36th Annual AATCC Convention.

(*1*), 0.24 acre of high-rate trickling filter was constructed, together with secondary subsiding basins, sludge beds and storage basin and pumps for equalizing the flow of primary subsiding basin effluent over the 24 hours, designed to handle 3.0 mgd/24 hours (*2*). The low-rate trickling filter and intermittent cinder filter were continued in service. In 1953, continuous pH indicating equipment was installed on the raw wastes line ahead of the primary subsiding basins, together with control equipment to automatically apply waste acid, previously discharged directly to the river, to the raw wastes. The supply of waste acid has not been continually available, because of finishing plant operations, in the ensuing years, and the cost of purchasing the requisite amount of acid for wastes neutralization has been prohibitive.

The primary subsiding basins are manually cleaned; the secondary ones are mechanically cleaned.

The flow equalizing manhole contains a long weir, over which flows in excess of the desired dosing rate for the trickling filters discharge to an equalizing storage basin. When the flow of wastes from the primary subsiding basins is less than the desired dosing rate for the trickling filters, a float control in the equalizing manhole starts a variable-speed pump, which draws wastes from the equalizing storage basin at rates sufficent to maintain the desired rate of filter dosage.

In 1954, the intermittent cinder filter was clogged with the by-products of 31 years service and required replacement. The cost of replacement of media and the cost of maintenance of this filter were not deemed practical because of the small portion of the total wastes flow handled by it, in spite of its high degree of BOD removal (*2*). It was, therefore, divided into sections for use as secondary sludge beds.

Figure 2, a flow diagram, shows the present layout of the plant, with sizes of various components.

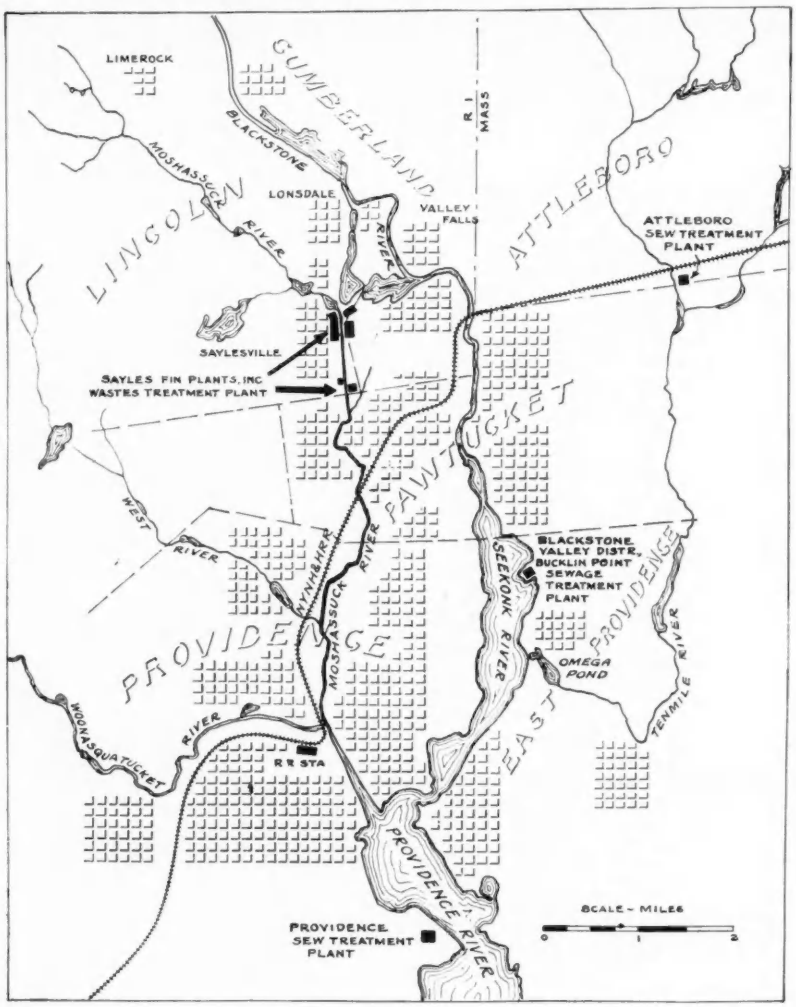

Figure 1
Location plan

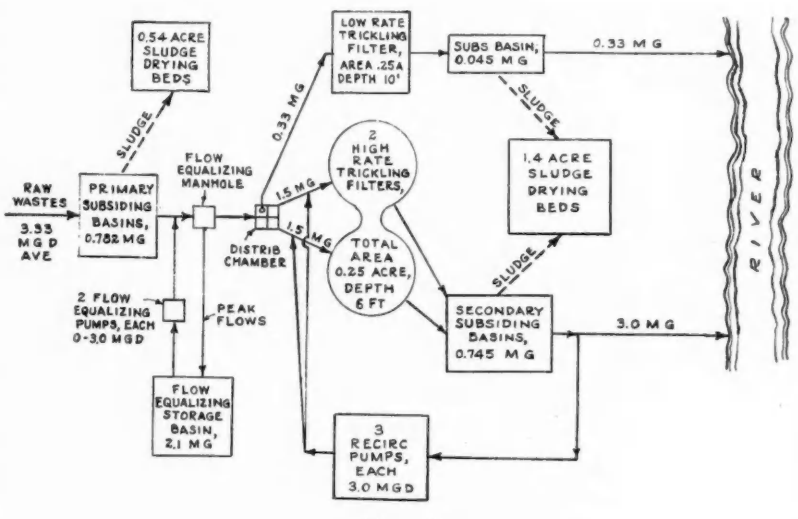

Figure 2
Flow diagram

CHARACTER OF RAW WASTES

The finishing processes which result in these wastes are bleaching, dyeing, printing, mercerizing and various special finishing processes. Domestic sewage from mill toilets and from a portion of the mill village is also included. The character of the mixed wastes reaching the treatment plant will vary from week to

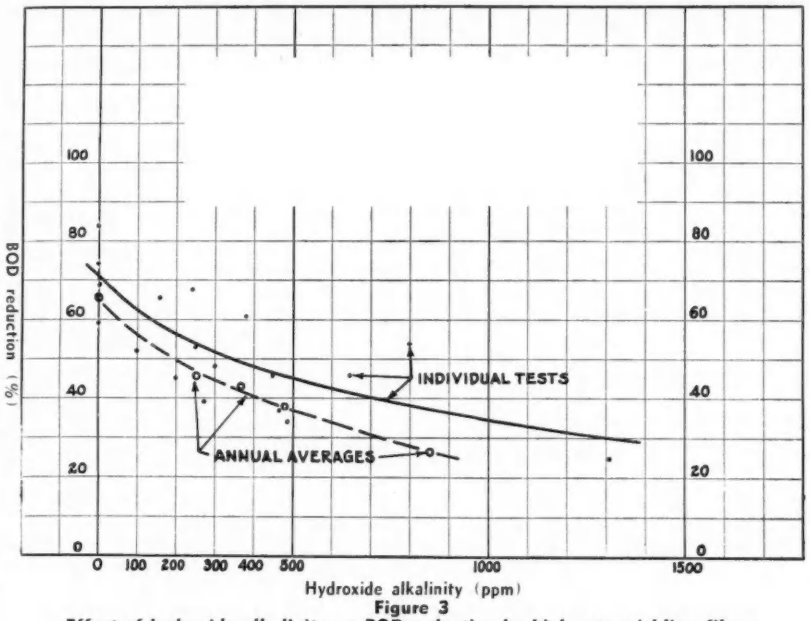

Figure 3
Effect of hydroxide alkalinity on BOD reduction by high-rate trickling filters

TABLE I
Average analysis of cotton finishing wastes at Sayles Finishing Plants, Inc

Constitutent		*ppm**
Turbidity		174.
Oxygen consumed		308.
Nitrogen as	free ammonia	2.58
	total albuminoid	3.92
Alkalinity	total	562.
	hydroxide	324.
	carbonate	238.
	bicarbonate	0
Hydrogen ion conc, pH		10.2
Residue on evaporation	total	1902.
	suspended	160.
	dissolved	1742.
Mineral residue	total	1533.
	suspended	64.
	dissolved	1469.
Dissolved oxygen, ppm		2.4
Dissolved oxygen, % sat		36.
Biochemical oxygen demand		247.

*Except as noted; from yearly averages, 1952–1957.

TABLE II
Volumes of wastes and rates of operation—1952-1957

Total flow:		2.5 to 3.3 mgd
To high-rate trickling filter		2.0 to 3.0 mgd
To low-rate trickling filter		0.3 to 0.6 mgd
Primary subsiding basin:	detention period	5.7 to 7.5 hours
	surface loading	405 to 540 gpd/sq ft
High-rate trickling filter:	net loading	8.0 to 12.0 mgad
	net loading	1.5 to 2.0 lbs BOD /cu yd
	recirc ratio	2 : 1
Low-rate trickling filter, loading		1.2 to 2.4 mgad
Secondary sub basin, low rate:		
detention period		3.6 to 1.8 hours
surface loading		310 to 620 gpd/sq ft
Secondary sub basin, high rate:		
detention period		2.0 to 3.0 hours
surface loading		540 to 815 gpd/sq ft

week with relative plant activity in the different processes, and from hour to hour with batch discharges of wastes from various finishing processes. Domestic sewage is estimated to make up from two to four percent of the total volume treated. Table I shows the average analysis of raw mixed waste samples collected on four to six test days per annum, with each day's sample collected in integrated portions.

Table I indicates that, over the five-year period, the BOD was similar to that of average domestic sewage, while the nitrogen content was much lower, and the solids, pH, alkalinity and oxygen consumed were much higher than typical domestic sewage.

VOLUMES AND RATES

Table II shows the average volumes of wastes handled and the rates of operation of the units of the treatment plant in the period 1952-1957.

PERFORMANCE OF TREATMENT PLANT

Table III summarizes the average reduction in various constituents by the components of the treatment plant. The primary subsiding basins contain relatively few settleable solids, compared to domestic sewage, hence the reduction in pollutants by these basins is relatively low.

The reduction of BOD is influenced by the alkalinity of the wastes. Table IV shows by results of individual tests, the effect of alkalinity of the raw wastes on BOD removal by the high-rate and low-rate plants. Figure 3 shows graphically how consistently the degree of BOD removal varies inversely as the hydroxide alkalinity. When the raw wastes have a pH between 10.5 and 11.5, and a hydroxide alkalinity between 100 and 1310, reduction in BOD by the high-rate trickling filters runs from 25 to 66%; when the pH has been 7.7 to 7.8 with no hydroxide alkalinity, BOD reductions by the high-rate plant have varied from 74 to 84; and when the pH has dropped too low for a short period, as shown by the first two tests, the BOD reductions have been 59 and 69%, better than under highly alkaline conditions.

SIGNIFICANCE OF RECEIVING WATER

Since the aim of wastes treatment is to abate pollution of a receiving water, it is obvious that the type and degree of treatment will be affected to some extent by the planned use of the receiving water.

The plant described above is located on a stream of Classification D; the requirements are chiefly the absence of scum and suspended solids and the presence of some oxygen to prevent anaerobic conditions with attendant odor nuisance. During

TABLE III
Efficiency of components of waste treatment plant from yearly averages, 1952-1957

	% Reduction BOD by				
				Whole Plant	
Item	*Primary subsiding basin (A)*	*High-rate trickling filter & secondary basin (B)*	*Low-rate trickling filter & secondary basin (C)*	*High-rate (A+B)*	*Low-rate (A+C)*
Turbidity	17.0	31.1	32.2	48.1	49.2
Oxygen consumed	9.6	27.4	31.2	37.0	40.8
Suspended solids	15.2	29.5	30.3	44.7	45.5
Biochemical oxygen demand (BOD)	8.8	46.7	54.2	55.5	63.0

Reductions based on raw wastes analysis in each case, so results are cumulative.

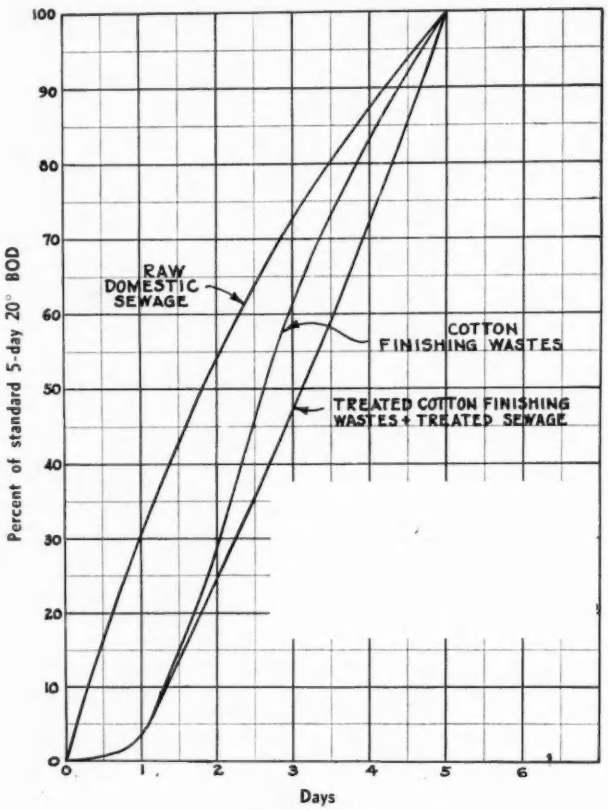
Percent of standard 5-day 20° BOD
Days
RAW DOMESTIC SEWAGE
COTTON FINISHING WASTES
TREATED COTTON FINISHING WASTES + TREATED SEWAGE

Figure 4
Rate of development of BOD in cotton finishing wastes and sewage

summer months there is often no water in the stream except the treatment plant effluent and 3.0 to 5.0 mgd of light wastes requiring no treatment. To offset this absence of dilution water, it is fortunate that tidewater is about five hours flow from the treatment plant. The significance of this geographical condition is shown in Figure 4, which shows the rate at which the BOD of domestic sewage develops, and corresponding curves for the effluent of this plant diluted only with light wastes but no stream flow, and plant effluent diluted with the effluent of an activated sludge plant handling domestic sewage. The significant lag in initial development of BOD in the plant effluent must be due to biological-inhibiting constituents in the finishing wastes—it means that, in this case, the potential 5-day BOD shown by conventional analyses never gets a chance to actually develop before substantial dilution of the effluent by tidewater. It also explains why the relatively rapid passage of these wastes through a trickling filter does not result in as great a BOD reduction as with domestic sewage.

Phelps, in his book "Stream Sanitation", expresses the significance of BOD in receiving waters, as follows: "The standard value makes a convenient descriptive term to employ in referring to the relative values of sewages or effluents, if properly identified as the 5-day, 20° value. On the other hand, it is only of limited value in the discussion of stream pollution, merely providing a datum from which, with the help of the combined time-temperature equation, it is possible to evaluate the BOD of the fluid in question under any stated conditions" (3).

This wastes-treatment plant has enabled the receiving water to comply with the requirements of its sanitary classification.

TABLE IV
Effect of hydroxide alkalinity of cotton finishing wastes on BOD reduction by trickling filters, as shown by individual tests

	Raw wastes		*% BOD reduction*		
	Hydroxide alkalinity (ppm)	*BOD ppm*	*By high-rate treatment*	*By low-rate treatment*	*pH*
	0	211	69	71	2.7
	0	310	59	73	3.8
	0	242	74	80	7.7
	0	353	84	87	7.8
	100	223	52	69	10.6
	160	155	66	70	10.7
	200	186	45	73	11.0
	243	242	68	62	11.0
	254	322	53	78	10.8
	270	304	39	44	11.0
	300	189	48	—	11.2
	380	199	61	73	11.3
	454	188	46	67	11.5
	470	236	37	44	11.1
	490	140	34	36	11.2
	650	241	46	—	11.2
	800	242	54	59	11.6
	1310	223	25	46	11.3
Average of all tests	340	234	53	65	9.9
Average of four tests with no hydroxide alkalinity	0	279	72	78	5.5
Average of two tests, no hydr alk or acidity	0	297	79	84	7.8

SUMMARY

1) Five years' experience at Saylesville indicates that cotton-finishing wastes having a pH in excess of 10.5 may be treated on trickling filters with a small admixture of domestic sewage, with BOD reductions averaging 50% to 60%.

2) Neutralization of wastes will enable the same trickling filters to reduce BOD 60% to 80%.

3) Mixtures of cotton finishing wastes with a small percentage of domestic sewage show a very slow BOD in one day, compared with domestic sewage.

ACKNOWLEDGMENT

Acknowledgment is gratefully made by the author, of the cooperation of the Sayles Finishing Plants, Inc, in making available the data contained in this paper.

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36th Annual Convention———

POLLUTION CONTROL OF NEW ENGLAND INTERSTATE WATERS*

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The New England Interstate Water Pollution Control Commission Administers a Compact ratified by the six New England States and New York for the control of water pollution in the interstate inland and tidal waters of the area. The Compact is based on a system of classification of waters according to proposed highest use with physical, chemical and bacteriological standards established for each class.

To assist industry, the Commission initiated an industrial waste research program in 1949. The first project was an industrial water survey, which showed that, of the 822 plants in the area discharging untreated organic wastes to the waters, 398 were textile mills. Accordingly, special emphasis has been placed throughout the program on textile mill wastes including cotton, wool and synthetic fibers.

INTRODUCTION

FOR centuries our clean waters were abundant, but through selfishness they have deteriorated, through complacency and apathy they are being wasted and their utility greatly impaired. To meet the ever-increasing demands for clean waters, public attention during the past decade has been focused on stream pollution control as the easiest and most practical method of augmenting our water resources for meeting the various requirements of our changing social and economic life.

The State Sanitary Engineers in New England met in 1946 to devise some form of agreement on the control of pollution of the interstate waters of the region. This action was prompted by two factors: first, New England is virtually a network of interstate streams crossing and recrossing State lines and in many instances forming a portion of the boundary between two States, and, secondly, there were numerous bills in Congress, all of which would delegate to some Federal agency mandatory powers to control pollution of interstate waters. The State Sanitary Engineers recognized that the solution of interstate water-pollution problems in the region must be a coordinated venture, and that, in as much as the States themselves, acting together, were in the best position to evaluate their needs in this respect, a compact arrangement was the logical and most democratic approach.

In 1947 the New England Interstate Water Pollution Control Compact was drafted and in the same year ratified by the legislatures of Connecticut, Massachusetts and Rhode Island and approved by an act of Congress. New York, which was eligible to become a signatory because of waters in that State common with those in New England, ratified the Compact in 1949. Vermont and New Hampshire became signatories in 1951, and the roster of eligible States was completed by Maine's ratification of the Compact in 1955.

The Compact is administered by the New England Interstate Water Pollution Control Commission, which is composed of five representatives from each of the seven signatory States. The manner in which the commissioners are chosen and their terms of office are specified in the ratification legislation of each State. Several of the commissioners are State officials in charge of departments or divisions concerned with pollution control, and the others are appointees of the respective Governors. The membership of the Commission provides representation of the many interests involved in pollution control, including public health, conservation, engineering, industry and the legal profession. An important adjunct to the Commission is the Technical Advisory Board, which consists of the directors of the State pollution-control agencies, under whose direction the technical phase of the work is conducted. The operations of the Commission are financed by annual appropriations from the signatory States, based on the population and valuation of each State within the Compact area.

The area embraced by the Compact includes 65,000 square miles with a population of about 9,200,000 and is the second most densely populated area in the United States. It is the most highly developed industrial area in the Western Hemisphere and its economy rests on the base of 24,000 manufacturing plants, their $15 billion output and their $5 billion total annual payroll. The industries are diversified with textiles, metal products, paper and leather goods being the leading products manufactured.

Probably no other section of the country is endowed with such extensive water resources as those which constitute the basis of New England's industrial development. Recreational facilities dependent on these resources are an integral part of the economy of the area. The extent of the water resources involved in the pollution-control programs is apparent from statistics showing that the Compact area contains about 3,500 square miles of water surface, over 75,000 miles of streams, and has a coastline of approximately 4,600 miles.

CLASSIFICATION OF WATERS

Recognizing the necessity of a balanced use of our waters to meet the various degrees of water quality required for the proper maintenance of our social and economic well-being, the Compact is built around a classification of waters according to recommended highest use. This classification system, which is based on accepted water quality standards, reconciles the conflict of water uses by the assignment of classifications which are deemed to be in the best interests of the public, after due consideration of all factors involved.

The Tentative Plan for Classification of Waters, which has been adopted by the Commission, defines the classes of water according to 1) suitability for use and 2) standards of quality, as shown in Table I.

In general, the classification systems of the New England States and

*Presented November 14, 1957 at the Textile Waste Disposal Symposium held during the 36th Annual AATCC Convention.

TABLE I

New England Interstate Water Pollution Control Commission
Tentative Plan for Classification of Waters
(as revised and accepted December 8, 1950)

	CLASS A	CLASS B	CLASS C	CLASS D
SUITABILITY FOR USE				
	Suitable for any water use. Character uniformly excellent.	Suitable for bathing and recreation, irrigation and agricultural uses; good fish habitat; good aesthetic value. Acceptable for public water supply with filtration and disinfection.	Suitable for recreational boating, irrigation of crops not used for consumption without cooking; habitat for wildlife and common food and game fishes indigenous to the region.	Suitable for transportation of sewage and industrial wastes without nuisance, and for power, navigation and other industrial uses.
STANDARDS OF QUALITY				
Dissolved oxygen	not less than 75% sat	not less than 75% sat	not less than 5 ppm	present at all times
Oil and grease	none	no appreciable amount	not objectionable	not objectionable
Odor, scum, floating solids, or debris	none	none	none	not objectionable
Sludge deposits	none	none	none	not objectionable
Color and turbidity	none	not objectionable	not objectionable	not objectionable
Phenols or other taste-producing substances	none	none	none	
Substances potentially toxic	none	none	not in toxic concentrations or combinations	not in toxic concentrations or combinations
Free acids or alkalis	none	none	none	not in objectionable amounts
Coliform bacteria	*Within limits approved by State Department of Health for uses involved.	Bacterial content of bathing waters shall meet limits approved by State Department of Health and acceptability will depend on sanitary survey.		

*Sea waters used for the taking of market shellfish shall not have a median coliform content in excess of 70 per 100 ml.

NOTE: Waters falling below these descriptions are considered as unsatisfactory and as Class E.
These standards do not apply to conditions brought about by natural causes.
For purpose of distinction as to use, waters used or proposed for public water supply shall be so designated.

New York State correspond with that of the Commission and can be expressed readily in terms of the Compact's classification plan. This is one of the reasons the Compact standards are in broad terms and are not as specific in detail as in some of the States. Under the terms of the Compact, each signatory State agrees to prepare classifications of its interstate waters according to present condition and proposed highest use and to submit them to the Commission for approval. After approval by the Commission, the States involved are pledged under the terms of the Compact to establish programs of treatment of sewage and industrial wastes to bring about the improvements required to meet the approved classification. The Commission has no authority to issue orders for pollution abatement. Such powers are retained by the individual States and used when needed to enforce classification requirements.

The Commission has approved classifications submitted by the States for the following interstate waters, and abatement programs for compliance with the classifications are under way:

Connecticut River (Mass-Conn)
Beaver Brook Basin (NH-Mass)
Pawcatuck Basin (Conn-RI)
Quinebaug Basin (Mass-Conn-RI)
Saco Basin (NH-Me)
Salmon Brook Basin (Mass-NH)
Taunton River-Mount Hope Bay (Mass-RI)
Ten Mile Basin (Mass-RI)
Walloomsac Basin in Vermont (NY-Vt)
Housatonic Basin (Mass-Conn)

In all other interstate basins, classification studies are being conducted by the various States preliminary to preparing proposed classifications.

All the States in the Compact area now have effective water-pollution-control laws as the result of the increasing public demand for clean waters. Connecticut, Massachusetts and Rhode Island were the first to recognize the necessity of control laws because of concentrated populations and many large waste-producing industries. In recent years New York, Vermont, New Hampshire and Maine enacted comprehensive laws which include the adoption of classifications for all waters of these States. The authority to classify is delegated to State boards in New York and Vermont, while in New Hampshire and Maine classification is a legislative prerogative. The laws of Massachusetts, Rhode Island and Connecticut do not require classification, but the classification plan of the New England Interstate Water Pollution Control Commission is employed as the basis for their stream-pollution-control programs.

Classification is proving a most valuable asset in water-pollution-control work on both interstate and intrastate waters in the Compact area because it provides a composite picture of the present condition of a river and the ultimate water quality objectives to be achieved. It presents a feasible and economic plan for pollution abatement, incorporating both the results of comprehensive studies by the State water-pollution-control agencies and the desires of all interests concerned as expressed at public meetings and group conferences. Classification focuses publicity on the problem by providing the citizens and their municipal leaders, and the industries and other groups concerned, with a definite basis for supporting remedial measures.

TEXTILE WASTE RESEARCH

In 1949, the New England Interstate Water Pollution Control Commission inaugurated a program of industrial waste surveys, investigations and research to assist the industries of the Compact area in solving waste treatment and disposal problems. Annual grants for the program were received by the Commission under the Federal Water Pollution Control Act of 1948 until their discontinuance in 1953. Under Public Law 660 of 1956, grants again became available and the program has been resumed on the same scale. For the most part the projects have been sponsored by the Commission under agreements with the University of Rhode Island and Wesleyan University in Connecticut. The research work at the University of Rhode Island has been conducted at the Engineering Experiment Station under the direction of Professor Henry Campbell; and at Wesleyan University, M G Burford has supervised the studies at the Hall Laboratory of Chemistry. Since its inception, the program has been coordinated with the research work of governmental and industrial agencies to prevent any duplication.

The first project undertaken was an industrial waste survey to obtain an over-all picture of the industrial waste problems in the area and the relative importance of each industry in the pollution control program. This survey conducted by the University of Rhode Island showed that there were 374 metal, chemical, and rubber plants in the Compact area producing toxic wastes, 224 of which discharge untreated toxic wastes to waterways. There were 1,531 plants producing organic wastes, 822 of which discharge untreated wastes to waterways; the remainder discharge to municipal sewers or have treatment facilities. Of the 822 plants, textile mills headed the list with 398 plants discharging a total pollution load equivalent to a population of 2,224,000; in second place were the 121 pulp and paper mills with a population equivalent of 1,987,000.

In view of the textile industry being the largest contributor of wastes and faced with treatment problems of a complex nature, special emphasis has been placed throughout the program on studies of textile-mill wastes. A critical review of the literature on textile wastes was made by Wesleyan University for the Commission to bring up-to-date the bibliography published by the Textile Foundation in 1936. The Commission then sponsored a joint project in 1952 at Wesleyan University and the University of Rhode Island for comprehensive cotton-finishing waste studies at two of the largest plants of this type in New England. The resulting report created considerable interest because it embodied a new principle—the substitution of low oxygen-demanding process chemicals for high oxygen-demanding chemicals as a means of reducing pollution. Several chemical manufacturers immediately evinced an interest in this possible contribution to pollution control.

In 1953, a similar study was undertaken at Wesleyan University on wool-mill wastes, the report on which provides a companion report to the one on cotton-finishing wastes. The study was conducted at a Connecticut mill, which uses all the processes typical of a woolen mill from the scouring of grease wool to the finishing of the cloth. As in the case of the study of cotton-finishing wastes, the report showed the possibility of substantial reductions in pollution by changes in processes and the process chemicals used. A project was then initiated at Wesleyan to study the wastes from synthetic fiber mills in order to cover all the textile fibers.

TABLE II
BOD reductions obtainable in wool processing through process changes

	BOD	
	lbs ptpc*	% Reduction
METHOD I		
Scour with soap	250	
Stock dye with acetic acid	49	
Card		
Full with soap	150	
Wash with soap		
Neutralize after carbonizing	2	
Total	451	—
METHOD II		
Scour with syndet	221	
Stock dye with ammonium sulfate	9	
Full with syndet		
Card with 20% BOD oil	64	
Wash with syndet		
Neutralize after carbonizing	2	
Total	296	34
METHOD III		
Solvent scour, recover grease	0	
Wash out suint salts with syndet	100	
Stock dye with ammonium sulfate	9	
Card with 3% BOD oil		
Full with syndet	59	
Wash with syndet		
Neutralize after carbonizing	2	
Total	170	62
METHOD IV		
Solvent scour, recover grease and suint	0	
Wash with syndet	10	
Stock dye with ammonium sulfate	9	
Card with 3% BOD oil		
Full with syndet or acid	30	
Wash with syndet		
Neutralize after carbonizing	2	
Total	51	89

*Pounds per 1000 lbs of cloth.

The study was conducted at Connecticut mills and included those synthetic fibers which are in common use namely, rayon, acetate, nylon, Orlon and Dacron. The report on synthetic fiber mill wastes indicated also that process changes and process chemical substitution would result in reduced pollution. The work on the three textile-waste reports was summarized in the synthetic fiber report from which the following is excerpted:

"Results from the three textile waste surveys (cotton, wool, and synthetic fibers) indicate that pollution loads originate from either of two sources: "natural" impurities in the fiber or process chemicals used in weaving and finishing the cloth. In all plants except woolen mills which scour grease wool, the "natural" impurities contribute less than 20-30% of the total BOD load. In grease-scouring woolen mills the "natural" impurities in the wool contribute approximately 50% of the total load. These results indicate, therefore, that approximately 80% of the BOD load from most textile mills is due to the process chemicals used to finish the cloth. Many of the process chemicals used have been found to have high BOD's and also to be replaceable by chemicals with low BOD's. By this method, pollution reduction through process chemical changes may be obtained. This method of reduction is the easiest, most economical way to abate pollution and should be thoroughly investigated and widely used by the textile industry. Results in all of these surveys indicate that BOD reductions of 50-90% may be obtained in this manner in any textile mill, regardless of the nature of the fiber being processed."

An example of pollution reduction as outlined in the report is shown in Table II.

In continuing the research on textile mill wastes, the Commission has entered into an agreement with Wesleyan University to provide an actual demonstration of the practicability and effectiveness of the proposals for pollution reduction as set forth in the reports on cotton, wool and synthetic fiber mill wastes. In cooperation with the Connecticut State Water Commission, one mill of each type had been selected and management approval obtained to conduct the studies. Also under way at Wesleyan are studies of treatment methods for textile wastes in areas where process chemical substitution may not be feasible and a project involving the design and application of automatic controls in waste collection and treatment.

At Rhode Island, a project sponsored by the Commission is nearing completion on the design, operation and efficiency of textile waste treatment plants. The report will include a flow diagram and design and operational data for each textile waste treatment plant in the counry. Of considerable interest are studies being made by the University of Rhode Island in connection with the system of lagoons recently installed by the Bradford Dyeing Association in Rhode Island to comply with the classification approved by NEIWPCC for the Pawcatuck River. While lagooning as a form of treatment has been employed with considerable success for sewage and certain industrial wastes, this marks its first application in the textile waste field.

As the pollution control programs advance and the States are requiring conformance with the classifications being adopted, the textile and other waste-producing industries are faced with instituting pollution abatement. Industries and municipalities have a joint responsibility in cleaning up our waters and the latter have made tremendous strides in this respect in

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TREATMENT OF MIXTURES OF TEXTILE WASTE AND DOMESTIC SEWAGE*

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The treatment of textile waste has long been considered a difficult problem due to variability, strength, and alkaline nature of the waste. Many consultants in the past have stated that combined treatment with sewage was not feasible without expensive chemical pretreatment, and therefore, separate treatment recommendations have prevailed.

This paper is a discussion of research at Cone Mills to evaluate combined treatment against separate treatment with and without pretreatment. The methods investigated include physical, chemical and biological processes, particularly the effect of lagooning as an aid to waste treatment. Conclusions indicate that biological treatment of combined textile waste and domestic sewage without chemical pretreatment is practical and economical. Lagooning can be expected to reduce both initial cost and operating expenses.

I. INTRODUCTION

THE continued industrial expansion of our nation is progressing at an increasing rate due to a number of factors, such as, rising standard of living, more industrial automation, and an increasing population. New industries, as well as old, are recognizing the importance of the proper use of water; its storage, use, removal of impurities, and the return of clean water to the stream. There is an ever-increasing problem in the minds of industrial planners as to water supply and waste disposal. These two factors are just as important in selecting a site for a new industrial plant as the source of labor or transportation facilities. Therefore, it becomes a proper function of a textile research laboratory to carry on research in waste reduction and waste-disposal problems.

The textile industry has contributed much in the past to solve its waste problems, and commendable progress has been made both in the treatment and prevention of waste. The American Association of Textile Chemists and Colorists has played an important part in this progress by coordination and dissemination of information through its national and sectional committees on stream pollution. Many benefits in more effective and economical treatment of wastes have been derived through the cooperative efforts of these AATCC research groups.

II. PROBLEM

The important problem to the textile industry today is to find the most effective treatment of its waste at the most economical cost. Textile wastes have long been considered one of the most difficult and complex wastes to treat because of strong dye and highly alkaline or acid content. These wastes not only vary in character, strength, and alkaline content, but also differ from plant to plant.

There is an increasing need for research on more economical means of treatment.

Present design costs for conventional waste-treatment plants are excessively high. Recent research has shown that satisfactory results can be obtained at approximately half the cost in a smaller plant by simply modifying the process. Industry will cooperate more readily if costs are reasonable, otherwise it may be forced to seek a location where wastes can be treated more competitively.

A good example of how research should be focused on economics is lagooning, which is a very-low-cost treatment that has shown reduction in BOD as high as 50% when used ahead of filters and aeration units.

This paper will deal with research at Cone Mills on the pollutional effect of textile waste and on various methods of treating these wastes with some evaluation to provide the best answers to the following questions:

1) What can be done to reduce the amount of waste to be treated?
2) Is segregation better, or necessary, before treatment?
3) Is it practical and feasible to treat textile waste with domestic sewage in municipal plants? If so, in what proportions?
4) What methods are most economical to treat textile waste?
5) Is chrome harmful to waste treatment processes?

III. KINDS OF WASTE PRODUCED IN COTTON TEXTILE PLANTS

In a review of the processes usually used in the cotton textile industry to convert fibers into finished goods, it is obvious that only certain of these processes produce liquid waste. In general, the processes that are connected with preparation for weaving, preparation for dyeing (cleaning), dyeing and finishing produce most of the objectionable waste that requires disposal. Typical examples of cotton processing wastes are found in Table I.

A) PREPARATION FOR WEAVING (SLASHING)———The slashing or sizing mixture consisting mainly of starch and a softener is normally applied to the yarn in a machine called a slasher. This size is to strengthen the yarn, make it easier to handle on the loom, etc. The waste comes from the wash up of starch kettles, slasher machines, floor scrapings, and any little size material left over at the end of the week. The waste is very strong in pollutional material but low in volume. There are a number of compounds that can be used in sizing, among them starch, starch substitutes, polyvinyl acetate (PVA) and carboxymethyl cellulose (CMC). Numerous investigators have suggested the substitution of CMC for starch in warp sizing to lower the BOD load and many mills are now using this and other low-BOD substitutes.

B) PREPARATION FOR DYEING (CLEANING)———

1) *Desizing.* The size that was applied to the yarn during slashing and before weaving must be removed before dyeing and bleaching. It can be removed in three different ways:

a) in the caustic kier boil (then the desizing waste would be in the kier waste),
b) by acid desizing, or
c) enzyme or malt desizing.

The first method will not be discussed here as the waste would be in

* Presented by R H Souther on November 14, 1957 as part of the Textile Waste Disposal Symposium held during the 36th Annual AATCC Convention.

TABLE I
Typical examples of cotton processing waste properties (5)

Wastes	pH	Color	Alkalinity (ppm) Total	CO_3	HCO_3	OH	Cl_2 Demand ppm	DO ppm	BOD ppm	TS ppm	VS ppm	FS ppm	SS ppm
Slasher Waste (Cone Mills Laboratory Research)													
Strong	9.2	blue/grey	1,040	248	800	0	132	0	37,700	76,976	74,744	2,232	45,800
(directly from machine)	8.9	blue/grey	660	0	660	0	40	0	36,000	77,247	75,552	1,695	64,400
Weak	7.2	blue/grey	34	0	34	0	2.0	0	1,800	4,078	3,944	134	2,290
(washings from kettles, etc)	8.4	blue/grey	52	12	40	0	6.6	0	1,885	3,308	3,204	104	3,100
Desizing Waste													
Starch size	7.2	tan	202	0	202	0	—	0	5,130	23,000	12,780	10,220	1,260
Kiering Waste													
Pressure kier	13.1	brown	20,240	1,860	0	18,480	66.0	0	1,840	26,740	4,144	22,596	144
Open kier—First boil	10.0	brown	10,000	7,800	2,200	0	—	0	3,750	19,642	7,374	12,268	—
Second boil	9.8	brown	7,400	5,800	1,600	0	—	0	2,280	16,064	6,938	9,026	—
Continuous boil off	13.1	brown	20,400	6,600	0	13,800	—	0	5,750	39,605	14,715	24,890	210
Hot rinse	11.8	brown	265	90	175	0	—	0	63	366	242	124	12
Bleaching Wastes													
Chlorine	9.5	cloudy	310	90	220	0	—	–	119	2,310	442	1,868	39
Peroxide	9.6	cloudy	1,265	560	705	0	—	–	1,200	9,040	—	—	—
Mercerizing Waste	12.1	cloudy	9,282	275	0	9,007	—	–	15	10,398	1,621	8,777	20
Rinse	9.6	cloudy	125	110	0	15	—	–	52	641	230	411	8
Dyeing Waste													
Aniline black	—	black	38	0	38	0	—	0	840	831	413	417	196
Basic	6.3	varied	65	0	65	0	—	0	167	628	276	352	6
Developed	6.9	varied	—	—	—	—	—	0	200	8,140	670	7,470	—
Direct	7.5	varied	81	0	81	0	—	0	337	9,400	780	8,620	269
Indigo alkaline wash	11.9	tan	2,700	1,910	790	0	140	0	2,080	5,834	2,226	3,608	121
Indigo wash	11.25	blue	2,200	1,400	800	0	1,500	0	928	1,132	412	720	116
Naphthol	9.5	red	1,310	1,084	0	226	—	0	108	8,475	725	7,700	—
Sulfur bath	10.5	blue/black	4,200	3,600	600	0	3,815	0	3,000	36,980	4,320	32,660	3,340
Vat	9.6	varied	714	660	0	54	—	0	129	1,770	398	1,372	18
Color Shop Wash Wastes	9.0	grey	193	0	198	0	—	0	133	2,880	2,245	635	1,430
Finishing (Cone Mills Laboratory Research)													
Strong (from machine)	8.8	blue/grey	490	65	425	0	84	0	13,600	41,646	38,778	2,868	3,949
Weak	7.1	blue/grey	37	0	37	0	4.6	2.2	680	2,050	1,880	172	38

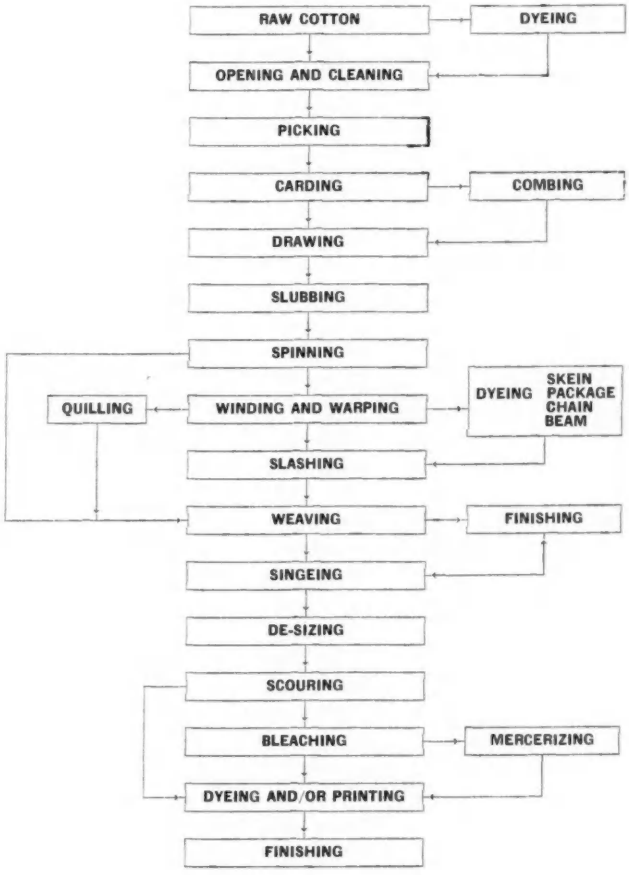
the kier waste and discussed under that subject.

The desizing operation is the same for either the acid or enzyme method. The cloth is run through the desizing solution, then into boxes where the cloth stays moist for several hours to allow the desizing agent to act. It is then washed to remove the starch, which has been hydrolyzed into soluble form (dextrines or glucose). The waste from either acid or enzyme desizing contains the starch size that was on the cloth. This waste is also strong but not large in volume.

2) *Kiering (scouring)*. Kier wastes are produced from boiling the greige goods in strong caustic (with or without pressure) to clean and make the goods absorbent prior to bleaching and dyeing. These wastes are moderately high in organic matter and are strongly alkaline. They contain:

a) natural vegetable fat, waxes, and pectins;
b) fragments of cotton bolls and other organic matter;
c) starch and other sizing material (if they have been used and not removed prior to kiering);, and
d) caustic soda, soda ash, silicate of soda (sometimes) and small amounts of other chemicals or oils used in the kier bath.

The goods are usually washed or rinsed in the kier, and can also be bleached there. The first rinse water following kiering is highly polluted, but it clears up as rinsing continues. The average pollutional characteris-



Flow sheet — operations from raw cotton to finished cloth

TABLE II

Type Dye	*Waste Water Composition*
Aniline	Aniline hydrochloride, sodium ferrocyanide, sodium chlorate, pigment, soap.
Basic	Dye, tannin, tartar emetic, acetic acid, finishing oil.
Developed	Dye, penetrant, sodium chloride, sodium nitrate, hydrochloric acid or sulfuric acid, developer (beta naphthol), soap or sulfated soap or fatty alcohol.
Direct	Dye, sodium carbonate, sodium chloride, and wetting agent or soluble oil or sodium sulfate.
Indigo	Dye, caustic soda, sodium hydrosulfite, softener, soap, sulfonated oil
Naphthol	Dye, caustic soda, soluble oil, alcohol, soap, soda ash, sodium chloride, base, sodium nitrate, sodium acetate
Sulfur	Dye, sodium sulfide, sodium carbonate, sodium chloride
Vat	Dye, caustic soda, sodium hydrosulfite, soluble oil, gelatine, perborate or hydrogen peroxide
Pigment	Pigment, ammonia, sodium alginate, resin

tics of the waste wash water depend on the amount of water used.

There are considerable variations in kiering practices; in some cases only a light kiering or "wet out" is used, while in other cases a double caustic "boil out" is used. The more rigorous kiering naturally removes a greater amount of the impurities and consequently produces a more polluting effluent. The well-scoured cotton is practically pure cellulose. The practice of kier boiling can be accomplished several ways. The method will depend on the mill and the type goods. The methods include: pressure kiering, scouring in jigs or dyeing machine, and open-width boil off (sometimes called continuous boil off). The heavy-type goods, eg, duck, sheeting, drills, etc, are usually kier boiled in open-width set-ups to eliminate crease and fold marks that would result if they were kier boiled in a regular pressure kier. The lighter goods and cotton or yarn are done in pressure kiers or dyeing machines. The waste volume from the kiering operation is considerable and strong in pollutional material.

3) *Bleaching.* The bleaching operation usually follows the cleaning or deterging process. Its purpose is to remove or destroy the natural coloring matter in the fiber. Chlorine, hypochlorite, and peroxide bleaching compounds are widely used in the cotton industry. The waste from chlorine and hypochlorite bleaching processes is similar in character (strongly alkaline, and containing the partially spent bleaching agents and the impurities removed from the cotton). The bleach is followed by washing, then an antichlor (which can be a one percent sulfuric acid solution,) the most common antichlor being sodium bisulfite. This process is called souring. The goods are then washed thoroughly and may be soaped and tinted to neutralize any retained chemicals and to soften and whiten the fibers.

Peroxide bleach can be applied directly in the kier bath or applied in a second kiering operation. The kier boil may contain peroxide, sodium hydroxide, sodium sulfate, sodium silicate, and a soluble oil. The souring and rinsing operations are similar to those used with chlorine bleaching.

4) *Mercerizing.* In the mercerizing of cotton, the goods are saturated with a cool caustic solution (room temperature) and immediately placed under tension. Most of the caustic is washed out before the tension is removed. The goods are washed thoroughly and treated with dilute acid to neutralize any residual caustic. The wastes usually consist of the wash waters as the mercerizing caustic is reused.

C) DYEING———The largest volume of waste waters in cotton processing comes from dyeing operations. The wastes for these dyeing operations are varied due to the different types of dye and the manner in which they are applied. The dye wastes are all large in volume, high in color, and some may be toxic. Table II is a list of dye types used on cotton and their corresponding waste composition after processing.

TABLE III

Toxic effects of various chemicals to fish and fish food (*11*)

Substance	*Concentration ppm*	*as*	*Test organism*	*Effect*
Chromic acid	0.3	Cr	daphnia magna*	toxic
Hydrochloric acid	63	HCl	daphnia magna*	toxic
Nitric acid	107	HNO_3	daphnia magna*	toxic
Sulfuric acid	88	H_2SO_4	daphnia magna*	toxic
Strong acids	to pH 5.0	—	fish	toxic
Cadmium chloride	0.01	Cd	goldfish	kills in 8–18 hours
Cadmium sulfate	513	Cd	minnows	kills in 3 hours
Copper sulfate	0.8	Cu	goldfish	kills in 24–96 hours
Copper sulfate	0.04	Cu	daphnia magna	toxic
Sodium chromate	0.1	Cr	daphnia magna	toxic
Potassium dichromate	36	Cr	goldfish	no effects in 108 hours
Potassium dichromate	180	Cr	goldfish	kills in 3 days
Chromate (ion)	20	Cr	trout and minnows	kills in 8 days
Chromate (ion)	50	Cr	sunfish, blue-gills	not toxic in month
Chromate (ion)	0.01	Cr	micro flora	toxic
Ferric chloride	34	Fe	goldfish	kills in 1–1.5 hours
Ferrous sulfate	37	Fe	goldfish	no effect in 100 hours
Ferrous sulfate	368	Fe	goldfish	kills in 2–10 hours
Nickel chloride	4.5	Ni	goldfish	kills in 200 hours
Lead nitrate	63	Pb	goldfish	kills in 80 hours
Stannous chloride	626	Sn	goldfish	kills in 4–5 hours
Zinc sulfate	25	Zn	trout	kills in 133 minutes
Zinc (ion)	0.3	Zn	fish	kills some freshwater fish
Sodium cyanide	0.3	CN	minnows, catfish, carp	no effect in 24 hours
Potassium cyanide	0.04–0.12	CN	goldfish	kills in 3–4 days
Cyanogen chloride	0.08	CNCl	fish	critical
Potassium ferrocyanide	948	CN	minnows, goldfish	not lethal
Potassium ferricyanide	848	CN	minnows, goldfish	not lethal
Ammonia	2.5	NH_3	goldfish	kills in 1–4 days
Ammonia	2.7	NH_3	fish	lethal
Hydrogen sulfide	10	H_2S	goldfish	kills in 96 hours
Sulfide (ion)	3	S	trout	kills in 5 minutes
Sulfide (ion)	0.5–1.0	S	fish	critical
Potassium cyanate	264	KCNO	trout fingerlings, adult minnows	no effect in 24 hours
Sodium hydroxide	156	NaOH	daphnia magna	toxic
Trisodium phosphate	52	Na_3PO_4	daphnia magna	toxic
Chlorine	0.05–1.0	Cl	fish	critical

*Daphnia magna is a representative fish food organism commonly found in streams.

D) COLOR SHOP (PRINTING)———The color-shop waste consists principally of wash waters used to clean print machines, rollers, color tubs, etc. The dye paste contains starch, so the volume and character of the waste depends on how freely water is used in washing and cleaning and how much dye paste is dumped to the sewer. The printing colors are expensive and a close watch is usually kept on dumping.

E) FINISHING———

1) *Plissé.* The waste from the plissé treatment of cotton goods consists of rinse waters containing acid and printing paste.

2) *Finishes.* Many types of finishes are applied to the cotton goods, usually starch, gums, waxes, resins, etc. The waste volume is small because the compounds are expensive. The waste will consist of kettle washings, machine washing, leftover baths at the end of run, etc.

IV. POLLUTIONAL EFFECT

The pollutional effect of cotton textile waste depends on many factors. As these factors vary, so does the effect of the waste on the receiving stream. Some of the factors are (*3*): volume of waste, type or make up of

TABLE IV
Effect of some chemical compounds on aerobic processes (*11*)

Substance	Concentration in sewage mixture ppm	as	Process-type	Effect
Chromic acid	4.68	Cr	filters	Stopped biological action entirely
Potassium dichromate	1.0	Cr	filters	Hardly affected nitrification
	10	Cr	filters	Reduced nitrification somewhat and lowered quality of effluent
	100	Cr	filters	Nitrification reduced 66–78% and organic matter increased 186–242% in effluent
Sodium or potassium cyanide	2.0	CN	filters	Reduces nitrification
Sodium or potassium cyanide	9.7	CN	filters	Effluent quality decreased but recovered quickly when cyanide addition was discontinued
Sodium or potassium cyanide	29	CN	filters	Effluent quality first decreased but at end of three weeks was as good as control, even with continued cyanide addition
Sodium cyanide	2.0	CN	activated sludge	Reduced nitrification somewhat
Sodium cyanide	40.0	CN	activated sludge	Reduces but does not completely prevent nitrification. Quick recovery after cyanide removal
Potassium cyanide	330	KCN	activated sludge	No effect, if acclimatized first
Nickel sulfate	1	Ni	activated sludge	Inhibited nitrification
Nickel sulfate	10	Ni	activated sludge	Has pronounced effect
Ferric chloride	(9 to		activated sludge	Retarding effect
Ferric sulfate	500			Retarding effect
Aluminum salts	ppm)			Retarding effect
Boron	1	B	activated sludge	Sludge will not settle

TABLE V
Effect of some chemical compounds on anaerobic digestion (*11*)

Substance	Concentration in sludge mixture ppm	as	Effect
Iron	—	—	Higher iron content caused faster digestion, but lowered gas production
Copper sulfate	(0.015%*)	Cu	No effect
	(0.030%*)	Cu	Reduced gas production to 12%
	(0.049%*)	Cu	Reduced gas production to 0.2%
Copper	150	Cu	Reduced gas production to 68%
	250	Cu	Reduced gas production to 0.5%
Copper hydroxide and copper sulfate	200		Increased gas production somewhat
	200	Cu	Decreased gas production
Potassium cyanide	40	CN	Reduced gas production to 40%
Sodium cyanide	1.1	CN	No effect
Sodium cyanide	1.6	CN	Retarded gas production when first introduced, but did not reduce total gas production
Sodium cyanide	16	CN	No effect, if sludge is first acclimatized by low initial doses
Nickel	500	Ni	Increases digestion activity, does not reduce gas production
	500	Ni	Reduces gas production
Zinc	1,000	Zn	Critical limit

*Based on volatile matter in sludge.

TABLE VI
Biological treatment of 40% textile waste and 60% domestic sewage by the activated sludge process; aeration time, six hours; pH adjusted to 8.5

Chromium content as ppm Cr — slight trace

Original Waste pH	BOD	Color	Effluent pH	BOD	Color	DO	% Reduction BOD	Color
10.0	289	600	7.5	99.5	450	0	65.5	25.0
10.6	301	600	7.3	86.6	300	2.6	70.0	50.0
11.1	325	400	7.3	49.8	175	3.8	85.0	56.2
10.3	176	350	8.2	25.5	150	5.8	85.4	57.2
11.5	224	350	8.0	21.1	120	3.8	90.6	65.7
11.5	362	900	7.6	70.2	400	2.2	80.6	55.6
						Average	79.5	51.6

TABLE VII
Biological treatment of 40% textile waste and 60% domestic sewage by the activated sludge process; aeration time, six hours; pH adjusted to 9.0 (acid) (*17*)

Chromium content as ppm Cr = ± 1 ppm

Date	Lbs acid to adjust pH to 9.0 on 11.2 mgd	% Removal BOD	Color
Sept 29, 1955	64,400	30.0	14.3
" 30	47,900	78.0	50.0
Oct 5, 1955	47,300	74.3	74.0
" 7	37,400	77.7	30.0
" 12	57,300	70.2	55.0
" 13	50,200	81.0	56.2
" 14	—	86.0	18.2
" 19	—	64.7	70.0
" 20	35,800	50.6	55.9
" 21	27,800	58.2	40.0
" 26	19,600	57.0	50.0
" 27	35,800	59.2	50.0
" 28	41,200	26.8	31.3
Nov 2, 1955	26,800	86.9	70.9
" 3	30,400	59.0	93.0
" 4	80,500	78.0	42.8
Average	41,919	64.9	50.8

waste (characteristics), flow pattern of waste, size of receiving stream or body of water, oxygen content of this receiving stream, and flow pattern of stream.

When a large quantity of suspended and dissolved inorganic matter is discharged into a plant effluent, it will cause a series of ills entirely different from those due to the discharge of large amounts of organic wastes. Large amounts of both inorganic and organic matter discharged in the plant effluent will further complicate the problem. The following is a discussion of the three primary pollutional effects which are due to textile processing wastes (*1*): toxicity to stream life, oxygen depletion in stream waters, and physical impairment of stream conditions.

A) TOXICITY TO STREAM LIFE ——There are many different chemicals used in the textile industry and these have various effects on biological treatment processes and on stream life. The list of toxic effect of various chemicals on the components of aquatic life (fish and fish food) are found in Table III. The effect of various chemicals on aerobic and anaerobic treatment processes are shown in Tables IV and V. In this connection, chromium is the offender most often mentioned. In research at Cone Mills the following was found:

1) *Chrome Concentration* (Tables VI and VII)

a) Below one ppm Cr—some loss of biological treatment efficiency.

b) One to two ppm Cr—efficiency loss 10-18%.

c) Shock loads of three ppm and over—causes a reduction in efficiency which picks back up quickly when chrome shock load has passed.

2) *Cyanide* (Table VIII)

a) Low concentration — biological process tends to acclimate to it to some degree after first shock and loss of efficiency.

b) High concentrations—shock load

TABLE VIII
Biological treatment of 40% textile waste and 60% domestic sewage by the activated sludge process; aeration time, six hours; pH adjusted to 8.5

Addition of cyanide as KCN

Conc as CN	Original waste			Effluent			% Reduction	
	pH	BOD	Color	pH	BOD	Color	BOD	Color
5 ppm	10.0	289	600	7.5	106.1	600	63.5	0
10 ppm	10.6	301	600	7.8	160.2	600	46.0	0
15 ppm	11.1	325	400	8.2	129.6	300	60.0	20.0
20 ppm	10.3	176	350	8.1	68.7	350	60.8	0
30 ppm	11.5	224	350	8.3	152	300	32.1	14.3
50 ppm	11.5	362	900	8.2	312	900	13.8	0
Average							46.0	5.7

TABLE IX
Biological treatment of 40% textile waste and 60% domestic sewage by the activated sludge process; aeration time, six hours; pH adjusted to 8.5

Addition of $K_4 Fe(CN)_6$

Conc as CN	Original Waste			Effluent				% Reduction	
	pH	BOD	Color	pH	BOD	Color	DO	BOD	Color
5 ppm	10.0	289	600	7.5	68.7	450	0	75.4	25.0
10 ppm	10.6	301	600	7.7	63.0	350	2.4	77.6	41.6
15 ppm	11.1	325	400	8.1	56.3	175	2.4	82.7	56.2
20 ppm	10.3	176	350	8.2	24.4	150	2.4	86.1	57.2
30 ppm	11.5	224	350	7.9	42.0	160	2.0	81.3	54.3
50 ppm	11.5	362	900	8.1	78.4	400	0.6	78.4	55.6
Average								80.3	48.3

causes a large reduction in efficiency.

3) *Ferrocyanide Compounds* (Table IX)

a) Low concentrations—no adverse effect.

b) High concentrations — no adverse effect.

The combination of chemicals found in textile waste can often produce a toxic condition in a receiving stream which is not only destructive to fish and aquatic life but has the effect of killing the bacteria and various other forms of biological life upon which stream self-purification processes depend. This is why it is important to review the type chemicals used in textile processes. The results of a study of a dyeing operation at Cone Mills brought about the replacement of sodium bichromate with potassium ferrocyanide for oxidation purposes, thus removing a toxic compound from the waste.

B) OXYGEN DEPLETION IN STREAM WATERS ——— Cotton processing wastes contain large amounts of organic constituents, materials that are unstable and tend to serve as food for bacteria in the stream waters (7). This process of decomposition results in the abstraction of dissolved oxygen from the water for the support of the bacterial life. Unless the oxygen carried by stream in solution is sufficient to oxidize this extra organic matter, all the oxygen will be depleted from the water. Then putrefaction will set in and septic conditions are created, which are accompanied by the characteristic effects of black, unsightly color, bubbling gases, and noxious odors. This is caused by anaerobic bacteria obtaining the oxygen they need from the organic compounds, which produces hydrogen sulfide (6).

C) PHYSICAL IMPAIRMENT OF STREAM CONDITIONS ——— The third characteristic of industrial wastes (particularly cotton processing waste) is one that is not of great hygienic importance but of utmost importance to the layman, that is, its physical appearance. The average citizen does not usually attach great importance to the really significant matters of hygienic quality, toxicity, and BOD, but bases his estimate of pollution almost entirely upon the physical evidences of color, turbidity, odor, and floating solids.

Color is the yardstick by which the layman judges damage. Inert inorganic matter may settle to the bottom of the stream and blanket the bottom in silt banks. These banks cover the natural bottom life in the stream, hinder the propagation of fish, obstruct navigation, and promote floods. Some of the organic matter in suspension may float and lodge along the banks and will become objectionable to the eye, while other portions settle with the inert inorganic matter and form sludge banks. These banks putrefy and give off objectionable odors (1).

A great deal of the pollutional effect of textile dye wastes will depend on the type dye used, the kind or type of cloth being dyed, and the specifications of the finished dyed cloth.

Several examples of the pollutional effect of cotton-processing waste follow, with the components that produce the pollutional load from the plant and the percent due each component. A typical cotton-finishing mill effluent will contain starch, dextrin, gums, glucose, waxes, pectins, alcohols, acetic acid, soap, detergents, sodium hydroxide, sodium carbonate, sodium sulfate, sodium silicate, sodium chloride, hydrochloric acid, etc (4). The pH will be between 8 and 11.0. Other characteristics will include: grey colloidal turbidity (the color depending on the dye most used); total solids, 100 to 1600 ppm; BOD, 200 to 600 ppm; total alkalinity, 300 to 900 ppm; suspended content, 30 to 50 ppm; and chromium content, one to three ppm.

Certain components produce the following pollutional pattern at a typical finishing mill (4):

	% of total BOD
Natural compounds in fibers (removed by kiering)	20–30
Desizing	35
Color shop	7
Wash after printing	6
Finishing wastes (50–60% BOD due to starch and its modifications)	0.5
Soap (can be replaced with detergent and cut 20%)	10–30
Acetic acid	11
Dyeing (this plant)	5

Another finishing mill produces the following pollutional waste pattern (13):

	% of total BOD
Desizing waste	52.5
Dyeing	37.2
Bleaching	10.3

It is noted from the above examples that the majority of the pollutional material comes from only a few sources.

The pollutional effects of various types of cotton processing waste are found in Table X.

The various impurities from textile-processing plants can also cause an increase in the expense for water purification for both domestic and industrial usage to remove color, hardness, etc. It can be expensive to develop an alternative water supply when the old one can no longer be used because of waterway pollution.

TABLE X

Pollution effect of cotton processing waste (composite of all wastes connected with each process) (5)

Process	Wastes (ppm) pH	BOD	Total solids	Gals wastes per 1000 lbs goods	Lbs BOD per 1000 lbs goods	Lbs total solids per 1000 lbs goods	Population equivalent per 1000 lbs goods
Bleaching (Range)	8.5–9.6	90–1,715	2,300–14,400	300–14,900	5.0–14.8	37.8–287.6	30–90
Desizing	–	1,750–5,130	16,000–32,000	300–1,100	14.8–16.1	66.4–70	90–100
Dyeing							
Aniline black	–	40–55	600–1,200	15,000–23,000	5–10	100–200	40–60
Basic	6–7.5	100–200	500–800	18,000–36,000	15–50	150–250	100–400
Developed colors	5–10	75–200	2,900–8,200	8,900–25,200	15–20	325–650	90–120
Direct	6.5–7.6	220–600	2,200–14,000	1,700–6,400	1.3–11.7	25–250	25–75
Indigo	5–10	90–1,700	1,100–9,500	600–6,000	1.8–9.5	21–63	10–60
Naphthol	5–10	15–675	4,500–10,700	2,300–16,800	2–15	200–650	13–80
Sulfur	8–10	11–1,800	4,200–14,100	2,900–25,600	2–255	300–1,200	14–1,500
Vats	5–10	125–1,500	1,700–7,400	1,000–20,000	12–30	150–250	75–175
Kiering	–	680–2,950	7,600–17,350	310–1,700	1.5–17.5	19.0–47.5	10–105
Mercerizing	5.5–9.5	45–65	595–1,930	27,900–36,950	10.5–13.5	184.0–448.5	60–80
Scouring	–	50–110	–	2,265–5,100	1.36–3.02	–	8–18
Slashing	–	625–2,490	8,500–22,600	60–940	0.5–5.0	47.0–66.5	2–30

V. METHODS USED TO STUDY A SOLUTION FOR THE PROBLEM OF WASTE DISPOSAL

A) WASTE REDUCTION INSIDE THE PLANT——A well-operated textile mill should be interested in waste-reduction procedures because a good waste-reduction program will save money. Any reduction inside the plant in the amount and strength of the pollutional material in the waste flow is reflected in the final treatment cost. It must be made clear in the minds of the plant personnel that this program is not a "checking up" or an efficiency study, but an attempt to determine the amount of wastes requiring treatment. An understanding of the program and the cooperation of the plant personnel is essential for its success. This phase of dealing with waste-treatment problems is often overlooked and the results are high disposal cost and larger treatment plants than are necessary.

The ways and means for reducing the amounts of pollutional material inside the plant before they get into the final effluent have been discussed in previous papers by the authors (*14, 17*) and will be covered here only briefly. The following list consists of some of the ways a plant may reduce its liquid-waste pollutional load, and a few short comments.

1) *Flow or Volume Reduction.* The waste flow may be reduced by the reuse of process water, counterflow washes, segregation of weak waste for disposal without treatment, changes in processes, etc.

2) *Reduction in Chemical Usage.* The reduction in amounts of chemicals used by closer process control, recirculation of wash waters, reuse of dyebaths, etc, is very important.

3) *Recovery and Reuse of Chemicals.* Many chemicals can be recovered and reused, eg, caustic soda.

4) *By-Product Recovery.* A close investigation of the processes involved may show up recoverable by-products, eg, heat recovery.

5) *Process Modification.* Changes in processes reduce the amounts and concentrations of waste material, eg, change in dyeing methods (standing bath).

TABLE XI

The BOD of a group of finishing compounds (*13*)

Compound	BOD based on 1000 ppm solution	Five-day BOD %*
Starch	477.0	47.7
CMC	9.0	0.9
Methylcellulose	1.6	0.16
Polystyrene (Stymer)	12.0	1.2
Polyvinyl alcohol	16.0	1.6
British gum	690.0	69.0

*Convert to ppm by multiplying by 10,000.

6) *Substitution of Chemicals.* The substitution of low BOD chemicals for high BOD chemicals is very important in a waste-reduction program. There are cases where plants have reduced their pollutional load by as much as 50% by substitution of a detergent for soap. Substitution examples include CMC for starch, mineral acids for acetic acid, detergents for soap, etc. (See Tables XI and XII).

7) *Good Housekeeping.* Good housekeeping is a result of day-to-day routine, cooperation, good design, and understanding of the problem.

B) TREATMENT OF LIQUID WASTE LEAVING PLANT —— The treatment of the remaining waste flow depends to a great extent

TABLE XII

The BOD of various types of detergent compounds

Name	Chemical composition	BOD ppm on 1000 ppm solution	Five-day BOD %‡
† Condensate PC	fatty amide condensate	242	24.2
† Dianol G	amide condensate	212	21.2
†* Duponol C	lauryl sulfate	1250	125
* Duponol D Paste	long-chain alcohol sulfate	450	45
* Duponol RA	fortified ether alcohol sulfate	330	33
* Duraline	solvent type	160	16
† Energetic	polyoxyethylene ester of a fatty acid	122	12.2
* Ethofat C/15	polyethoxyethanol fatty acid ester	1000	100
* Ethofat C/60	polyethoxyethanol fatty acid ester	200	22
* Ethomid HT/15	polyethoxyethanol fatty acid amide	1000	100
* Ethomid HT/60	polyethoxyethanol fatty acid amide	90	9
* Exol K 144	detergent	780	78
* Exol XP Special	detergent	700	70
† Hymolon K	fatty acid amide condensate	338	33.8
* Iberscour	detergent	530	53
* Igepal	polymerized ethylene oxide alkyl phenol condensation product	40	4
* Igepon T	$C_{17}H_{33}.CO.N(CH_3).C_2H_4.SO_3Na$	280	28
* Kreelon 8 D	sodium alkylaryl sulfonate	150	15
* Monatone A	built soap gel	200	20
†* Nacconol NR	sodium alkyl arylsulfonate	40,8.0	0,4,0.8
* Nacconol NRSE	sodium alkyl arylsulfonate	0	0
† Orvus AB granules	sodium alkyl arylsulfonate	1.4	0.4
† Orvus EC Paste	mod sodium alkyl sulfate type	237	23.7
* Orvus Neutral granules	mod alkylarylsulfonate	30	3
* Pluronic F68	polyglycol ethers	120	12
† Protenol K	protein and fatty acid condensate	450	45
* Rinsol	detergent	720	72
* Sandopan TLF	sulfonated fatty amide	50	5
†* Soap	fatty acid soap	1550	155
* Solpinol Special	pine oil compound	700	70
* Special Textile Flakes	soap	1120	112
† Sulfonole KB	sodium alkylarylsulfonate	0	0
* Syntholite #100	sulfated secondary alcohol	100	10
† Tergitol 4	$C_4H_9CH(C_2H_5)C_2H_4CH(SO_4Na)CH_2CH(CH_3)_2$	0	0
† Triton X-100	alkylaryl polyether alcohol	1.5	.15
†* Ultrawet—35K	sodium alkylaryl sulfonate	0	0
* Ultrawet DS	sodium alkylaryl sulfonate	0	0
† Ultrawet 60L	sodium alkylaryl sulfonate	2.4	0.2
* Xylol scour special	detergent	420	42

†Analyzed by Cone Mills Laboratory.
*Analyzed by Rhode Island Section Subcommittee on Stream Pollution (*12*).
‡Convert to ppm by multiplying by 10,000.

TABLE XIII

Physical treatment of mixed textile waste by lagooning (5000-gallon earth lagoon) Average results

	pH	BOD	Color	Alkalinity (as ppm $CaCO_3$) Total	Carbonate	Bicarbonate	Hydroxide	Odors
A) WITHOUT SEWAGE SEED								
Time: May to August								
Original mixture	12.2	520 ppm	909 ppm	1340	540	0	800	chemical (not objectionable)
After three days storage	12.14	486 ppm	943	1164	692	4	465	not objectionable
After seven days storage	12.2	477 ppm	899 ppm	1164	745	0	397	not objectionable
B) WITH 10% SEWAGE SEED								
Time: May to August								
Original mixture	12.0	481	845	1148	525	0	626	not objectionable
After three days storage	11.7	480	900	987	638	4	338	not objectionable
After seven days storage	11.8	449	835	935	701	3	278	not objectionable
C) WITH 34% SEWAGE SEED								
Time: August								
Original mixture	11.9	458	923	1042	584	0	466	not objectionable
After three days storage	11.7	393	945	1054	840	4	206	not objectionable
After seven days storage	11.7	409	981	1092	820	5	267	not objectionable

	% Reduction BOD	% Reduction Hydroxide alkalinity
A) WITHOUT SEWAGE SEED		
Three day	3	42
Seven day	12	56
B and C) WITH SEWAGE SEED		
Three day	8–11	44–53
Seven day	13–14	62–63

on the circumstances, that is to say, 1) the size of the receiving stream or body of water in relationship to the volume and strength of the waste, 2) the classification of this stream (what type waste allowed in it), 3) the further use of this stream, etc. All of these factors determine the type and amount of treatment necessary. In general, the larger the stream, the less treatment needed and required. For example, small volumes of finishing waste and a large receiving stream usually requires no treatment.

As to the feasibility of treatment in combination with domestic sewage in a municipal plant, this will depend on the situation, locale, plant location, municipal government, etc. If the industrial plant is located so that combined treatment is available and possible it should be investigated and used.

This combined treatment gives a lower overall cost than the separate treatment of domestic sewage or textile waste. In detail, it reduces capital outlay, provides more economical operation, places the treatment under skilled supervision, provides nutrients from the sewage for the textile wastes, provides dilution for the textile waste, and requires the operation of one rather than two treatment plans. Mixtures of textile waste and domestic sewage with pH's ranging as high as 11.5 have been satisfactorily treated through high-rate trickling filter activated-sludge units.

In cases where the treatment plant already exist and the textile waste is to be added for treatment (the majority of cases fall into this category), the need for enlarged facilities will depend on the type and amount of waste. In some cases no enlargement will be necessary, in others it will. In general, if the plant is an activated-sludge type, then additions of filters ahead of the aeration units would be the best method of enlarging the capacity. In other cases, such as trickling-filter plants for enlargement, it may be advisable to add extra filters, or sometimes, chemical precipitation. So much depends on the local conditions that blanket statements are difficult to make.

There have been and still will be situations where combined treatment is not practical and useful, but this is more the exception than the rule. In these cases, the plant waste must be treated separately in the most economical manner. There are three general methods used to treat industrial waste: physical, chemical, and biological. These methods have been covered in some detail by the authors in previous papers (*17*), so will only be listed here:

1) *Physical*: dilution, mechanical filtration, screening, equalization, separation, lagooning.
2) *Chemical*: neutralization, precipitation, oxidation.
3) *Biological*: *Fixed Media*—trickling filter, contact aeration
   Nonfixed Media: activated sludge, dispersed growth, endogenous respiration.

VI. RESULTS OF TREATMENT

A) PHYSICAL TREATMENT——The results of pilot-plant lagooning experiments (Table XIII) indicate that it may be used for BOD reduction, some color reduction, to change the hydroxide alkalinity to carbonate and bicarbonate alkalinity, and for flow and pollutional load equalization. The changing of the type of alkalinity is extremely important because biological filters are sensitive to high hydroxide alkalinity and this high hydroxide alkalinity will kill the biological growth.

B) CHEMICAL TREATMENT——

1) *Neutralization.* The fact that a waste may have a high pH (per se) does not always mean the waste must be neutralized, although with chemical treatment, sometimes pH adjustment may be necessary to the best coagulation range for the most economical total cost. Originally it was felt that all waste must be neutralized to pH 7 for successful biological treatment, but experiments have shown this was not necessary. As a result of past experiments, thinking was modified to the extent that the upper pH limit for biological treatment was 9.5 and above this, efficiency will fall off to such an extent that treatment would not be practical.

Experiments at Cone Mills have shown that high-rate trickling filters can operate successfully with good efficiency at pH's up to 10.5 (*15*). Above 10.5 up to 11.5 the efficiencies drop 10-40% (*16*). It's not so much the pH that counts, it's the hydroxide alkalinity that kills the growth. High-rate filters have been found to operate effectively with as much as 150-200 ppm hydroxide in the influent, but above this figure the efficiency suffers. In some cases lime has been added to the influent of a treatment plant to keep the alkalinity in the hydroxide range (50 + ppm) during the summer. Efficiencies have been raised to in excess of 95% with a sparkling clear effluent (*10*).

Close control of the pH and alkalinity is not as important in trickling-filter operation as it is in activated-sludge operation. The trickling filter can take shock loads very well and

recover rapidly, but ordinary conventional activated sludge cannot. Activated sludge needs regularity for best results and at pH's below 9.0 to 9.5. At pH above 9.0 to 9.5 efficiencies drop sharply, and at pH higher than 10 to 10.3 the activated sludge dies.

Neutralization is usually accomplished in two ways, either by addition of alkali or acid, (CO_2 gas can be used in place of acid). In a survey of the cost of the neutralization of alkaline waste, results showed 1) CO_2 from stack gas was the most economical method, 2) produced CO_2 from submerged burners less economical, and 3) acid treatment the most expensive.

2) *Chemical Precipitation.* Chemical treatment has proved through the years that, if handled properly, it will do a good job. Of course, coagulants and amounts which worked when the plant was new may not necessarily work now as plant operations change. Also, the cost has always been a drawback, as chemical treatment can be expensive.

The key to successful chemical treatment is to use the right chemical at the right place. The chemicals most often used are alum, copperas, lime, chlorine, sulfuric acid or a combination of these. (*18*) There have been many, many experiments on the treatment of cotton textile waste with various chemicals and combinations of chemicals. Tables XIV-XVII give complete data on the best chemicals to use for various types of wastes and results that may be expected.

3) *Chemical Oxidation.* Chemical oxidation may be used on waste of an organic nature. It can be carried out by various means, the usual ones being chlorine or air. These two proceed at different rates. Chlorine immediately reduces odors and oxidizes the organic part of the material; air proceeds more slowly, driving off objectionable gases to the atmosphere, then oxidizing the organic material.

C) BIOLOGICAL TREATMENT—The process of biological oxidation can be used to treat specific textile waste, mixed textile wastes, and mixtures of textile wastes and domestic sewage. In some cases with specific textile waste or mixtures of textile wastes, nutrients and/or seeding material are required. In those cases where nutrient materials are required, phosphate and nitrogen are added as phosphoric acid, ammonium chloride, potassium phosphate, etc. Seed material is added as sewage or excess activated sludge. When mixtures of textile waste and domestic sewage are treated combined, usually no seeding or nutrients are required as the sewage furnishes both the seed and the nutrient material.

It has been found, from pilot-plant experiments on various mixtures of textile waste and domestic sewage, that the proportion of textile waste to sewage has no effect on the treatability of the mixture. When textile waste contains no toxic substances, it treats just as well mixed with sewage as the sewage treats alone. The controlling factor is the acidity or alkalinity of the waste. The amounts of acid or alkali determine the results of the treatment. High-rate biological filters will operate well with hydroxide alkalinity concentrations up to 150-200 ppm, and there are cases where lime is added to increase the alkalinity and improve treatment. It was also found that the size of pilot-plant filter units was not as significant as expected. The difference in efficiencies between inside 1.25-foot diameter filters and outside four-foot diameter filters was less than three percent, which was well within experimental limits.

These biological pilot-plant experiments proved that textile waste can

TABLE XIV
Chemical treatment of dye wastes (*17*)

Dye wastes	Chemical	Lbs/1000 gals	Cost/1000 gals		Results: pH Change	Results: % Reduction Color	Results: % Reduction H_2S
*Aniline Black**	1) alum	0.9	2.2¢	2.58¢	6.5 to 7.0	83.8	
	lime	0.4	0.38¢				
	2) $FeSO_4$	2.3	2.04¢	3.62¢	6.5 to 6.9	80.0	
	lime	0.6	0.58¢				
	3) $FeCl_3$	1.5	8.8¢	9.38¢	6.5 to 7.7	83.8	
	lime	0.6	0.58¢				
	4) lime	6.3		6.05¢	6.5 to 11.7	80.0	
*Developed dyes**	1) $FeSO_4$	11.6	15.3¢	17.3¢	3.3 to 5.6	85.00	
	lime	2.1	2.0¢				
	2) $Fe(SO_4)_3$	18.3	18.5¢	48.5¢	3.3 to 7.0	65.00	
	lime	10.5	10.0¢				
*Direct dyes**	1) $Fe_2(SO_4)_3$	2.8		5.9¢	10.8 to 3.6	75.00	
	2) alum	7.4		18.0¢	10.8 to 4.3	75.00	
	3) $FeCl_3$	3.4		19.8¢	10.8 to 3.5	85.00	
	4) $FeSO_4$	3.5	4.6¢	54.6¢	10.8 to 11.9	90.0	
	lime	52.3	50.0¢				
Indigo	1) lime	7.0		6.7¢	10.5 to 11.8	65.00	
	2) $FeSO_4$	5.8	7.65¢	19.65¢	10.5 to 11.5	94.5	
	lime	12.5	12.0¢				
	3) alum	10.0		24.0¢	10.5 to 4.2	65.0	
	4) $CaCl_2$	154.0		$2.85	10.5 to 8.2	94.5	
*Naphthol dyes**	1) H_2SO_4	21.8		20.2¢	11.6 to 4.5	99	
	2) $Fe_2(SO_4)_3$	27.8		58.5¢	11.6 to 6.0	99.5	
	3) alum	55.8		$1.36	11.6 to 4.5	99.5	
	4) $FeCl_3$	33.9		$1.98	11.6 to 5.6	99.5	
Sulfur dyes	1) H_2SO_4	36.5		33.4¢	11.7 to 3.5	99.0	+
	2) alum	58.0		$1.41	11.7 to 5.0	99.0	+
	3) $FeSO_4$	214		$2.82	11.7 to 8.3	99.7	—
*Vat dyes**	1) $FeSO_4$	92.8	$1.22	$1.34	11.7 to 11.1	85.0	
	lime	12.5	.12				
	2) $FeSO_4$	116		$1.53	11.7 to 11	87.5	
	3) alum	232.5		$5.65	11.7 to 6.3	87.5	

*Bibliography (*9*).

TABLE XV
Chemical treatment of mixed textile wastes (*17*)

Waste	Chemical	Lbs/1000 gals	Cost/1000 gals		% Removal: BOD	% Removal: Color
Sulfur and Indigo	1) $FeSO_4$	5.85	7.8¢	13.4¢	41.5	91.0
	lime	5.85	5.6¢			
	2) lime	20.9		20¢	—	99
	3) alum	20.9	51¢	57¢	43.7	97.5
	acid	6.5	6¢			
	4) $CaCl_2$	24.6		60¢	42.5	85.0
	5) alum	37.2		91¢	—	99.4
Finishing waste	1) acid	2.0		1.85¢	none	none
	$FeSO_4$	4.2	5.55¢	9.55¢	50	80
	lime	4.2	4.0¢			
Kier waste	1) $FeSO_4$	145.0	$1.92	$2.04	—	98.0
	lime	12.6	.12			
	2) alum	83.7	$2.04	$2.10	—	99.0
	acid	6.5	.06			
	3) alum	130.2		$3.15	—	99.5
Kier finishing, dyeing, color shop, and mercerizing	1) $FeSO_4$	4.2		5.5¢	18.9	none
	2) $FeSO_4$	8.2	10.82¢	16.77	41.2	50
	lime	6.2	5.92¢			
	3) $CaCl_2$	10.0		24.4¢	49.5	60
	4) alum	16.7	40.8¢	45.2¢	60.9	82.5
	acid	4.7	4.4¢			
Dyeing and finishing	1) $FeSO_4$	5.85		7.75¢	42.2	80
	2) $FeSO_4$	4.2	5.55¢	9.55¢	52.5	80
	lime	4.2	4.0¢			
	3) $CaCl_2$	7.5		13.8¢	49.0	84
	4) alum	16.7	40.8¢	47.0¢	56.9	90
	acid	6.7	6.2¢			

TABLE XVI
Chemical treatment of a combination of mixed textile wastes (17)

Type waste: Mixed dye waste, finishing waste, kier waste, mercerizing waste, color shop

Original wastes mixture: pH 12.0; BOD 808; Color 954

Chemicals	Lbs/1000 gals	Cost/1000 gals		Results: pH Reduction	% removal BOD	% removal Color
Copperas	4.2		5.6¢	12.0 to 10.6	20	50
	7.8		10.3¢	12.0 to 10.4	30	70
Copperas	5.8	7.65¢	13.2¢	12.0 to 11.7	59.5	83.5
Lime	5.8	5.55¢				
$CaCl_2$	8.4		15.5¢	12.0 to 10.6	47.5	83
Alum and acid	8.4	20.5¢	23.7¢	12.0 to 6.0	40	83.0
	3.5	3.2¢				
	12.0 to 14.2	29.3–34.6¢	33 to 38¢	12.0 to 6.0	60–70	87.5
	3.5	3.2¢				

TABLE XVII
Chemical treatment of mill waste and sewage mixtures

45% Mill waste mixture and 55% sewage

Compound	Lbs/1000 gals	Cost/1000 gals		Results: % Removal BOD	% Removal Color
Copperas	2.5	3.3¢		62%	25%
Copperas	1.67	2.2¢	4.1¢	62.8%	61%
Lime	1.67	1.9¢			
$CaCl_2$	4.5	8.3¢		67.7%	75%
Acid	1.67	1.5¢	8.6¢	76.1%	81%
Alum	2.91	7.1¢			

TABLE XVIII
Biological treatment results in percent reduction

A) HIGH-RATE TRICKLING FILTER AND ACTIVATED SLUDGE

	One-stage trickling filter BOD	One-stage trickling filter Color	Two-stage trickling filter BOD	Two-stage trickling filter Color	Trickling filter & activated sludge BOD	Trickling filter & activated sludge Color	Activated sludge alone BOD	Activated sludge alone Color
40% Mill waste—60% sewage								
With pH adjusted	30–70	20–60	60–80	50–60	80–95+	60–87	65–80	50
Without pH adj	20–50	15–40	50–80	30–55	70–95+	45–75	37–dies	17
45% Mill waste—55% sewage								
With pH adj	20–60	25–30	55–75	50–60	85–90+	60–75	none	
Without pH adj	20–50	20–25	40–70	35–45	70–90+	45–60	none	
50% Mill waste—50% sewage								
Without pH adj	20–40	10–20	50–70	20–35	60–90	25–45	none	
84% Mill waste—16% sewage								
With pH adj	30–40	20–30	60–80	40–50	90–95+	65–80	none	

B) DISPERSED GROWTH AERATION

	% Reduction BOD	% Reduction Color
40% Mill waste—60% sewage		
With pH adj	40.1	13.0
Without pH adj	26.0	4.2

be treated in a variety of ways and at various costs. The type treatment used depends on strength and volume of the waste, cost, and degree of treatment required. As examples, in general, for small volumes of waste, activated sludge, dispersed growth (*8*) or endogenous respiration units can be installed more economically than trickling filters. As the amount of waste to be treated increases, the choice of treatment methods will depend on operation cost as well as the cost of the initial installation. For large volumes of wastes with a varying strength, and where a high degree of treatment is not necessary, a trickling filter works best, due to its ability to absorb shock loads and operate without close supervision. There are situations where a high degree of treatment is necessary on a variable-strength waste and then two-stage high-rate trickling filters or a one-stage high rate trickling filter and activated sludge produces best results.

Table XVIII summarizes the results of the biological pilot-plant experiments.

VII SUMMARY AND CONCLUSIONS

A) Combined treatment of mixed highly alkaline textile waste and domestic sewage is both feasible and practical even without chemical pretreatment, if hydroxide alkalinity is not excessively high.

B) Results from pilot-plant studies indicate that treatment of highly alkaline textile mill waste by trickling filter and activated sludge is better when combined with domestic sewage than when textile waste is treated separately from sewage.

C) When the highly alkaline textile mill waste was treated combined with domestic sewage without chemical pretreatment, through both trickling filter and aeration processes, the pollution of the resulting effluent was reduced sufficiently to be acceptable to a small receiving stream. When the highly alkaline textile mill waste was treated separately from domestic sewage, through trickling filter only, without aeration, but after expensive chemical pretreatment, the resulting effluent was not acceptable for release to a small receiving stream without additional treatment.

D) The combined treatment method is preferable in a single plant to separate treatment in two or more plants due to lower overall treatment cost and better supervisory control.

E) The pollutional waste load from a textile plant can be reduced substantially by a good waste reduction program inside the plant. The following are some of the methods:

1) Reduction in volumes or flows.
2) Reduction in amounts of chemicals by modern control methods.
3) Recovery and reuse of chemicals.
4) Recovery of byproducts.
5) Process modification.
6) Substitution of chemicals.
7) Good housekeeping practices.

F) Segregation of strong wastes is recommended when it allows a large volume of weak waste to be disposed of with little or no treatment and without expensive plant alterations (pipe changes, etc).

G) A lagoon can well be used as a waste reduction and control practice. It will cause reduction in BOD hydroxide alkalinity, total settleable solids, and some color removal. It will reduce temperatures and regulate flows and pollutional shock loads. Its ability to change hydroxide alkalinity to carbonate and bicarbonate alkalinity is extremely useful because of the adverse effect of high hydroxide alkalinity on biological growth. Experiments so far show that seeding of mixed textile waste before lagooning might be used to diminish storage time or to increase BOD

(*concluded on page P490*)

COMBINED TREATMENT—BLEACHERY WASTE AND DOMESTIC SEWAGE

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INTRODUCTION

AT the 1954 AATCC Convention held in Atlanta, I presented a paper entitled "Bleachery and Dyehouse Waste Studies" (*1*). I am happy to report that, as a result of these studies, a treatment plant was designed and built. It has been in operation for the past two years and is performing better than we had expected.

A brief revue of the results of the waste studies will help in the discussion of the treatment plant.

From the laboratory analysis of all waste-producing operations, it became apparent that segregation of the waste would be beneficial. We found that the waste could be divided into three general classifications as follows:

1) STARCH WASTE———The No. 1 Classification can be identified as starch waste, which is the waste produced in the desizing operation in the bleachery. It is chiefly starch and decomposes very rapidly. It constituted about 16% of the total volume of the waste being produced and contained 53% of the BOD, 36% of the total solids, and 6% of the total alkalinity.

2) CAUSTIC WASTE———The No. 2 Classification can be identified as caustic waste. It is composed of caustic solutions, impurities and starch that are washed from the goods before bleaching. It has a very high pH and can be held in storage without any rapid change in characteristics. This waste constituted about 19% of the total waste by volume and contained 37% of the BOD, 43% of the total solids, and 60% of the total alkalinity.

3) GENERAL WASTE———The No. 3 Classification can be identified as general waste. It is composed of waste from all washing, bleaching, dyeing and finishing operations that are not included in the first classifications. It constituted about 65% of the total waste by volume and contained 10% of the BOD, 21% of the total solids, and 34% of the total alkalinity.

With the approval of the AATCC Stream Sanitation Committee, it was decided to treat the first two classifications of our waste, namely the starch waste and the caustic waste. These two constituted 35% of the total waste by volume. They contained 90% of the BOD, 79% of the total solids and 66% of the total alkalinity.

It was decided to by-pass, for the present, the third classification, general waste, in order to reduce the size of the plant needed. And until the entire waste problem on the stream is solved, it would be enough to eliminate the odor problem in the receiving stream.

The general plan of treatment was as follows:

1) Segregate the waste at the bleachery in accordance with the classifications as described previously.
2) Store the caustic waste ahead of the plant in a lagoon in order to have seven-day operation and to provide means of pH control.
3) Treat the waste through a conventional two-stage high-rate trickling filter plant.
4) Chlorinate the effluent during the summer months.

Plans and specifications were prepared by the engineering department of Cannon Mills Company and submitted for approval early in 1955. Construction began in May 1955 and was completed in May 1956.

The existing 1.5 mgd low-rate trickling filter plant was incorporated in the final design. The plant capacity was enlarged to 3.0 mgd. Low-rate filters were converted to high-rate filters and a roughing filter added. Additional settling capacity was added and a chlorine contact tank was constructed. One additional digestor with a capacity equal to the two existing ones was built. Vacuum filtration of digested sludge was decided upon chiefly because of space requirements. Lime-slaking equipment was added at a later date. Three pipe lines were installed to convey the segregated wastes to the treatment plant. The plant was put back in full-time operation in June of 1956.

TREATING UNITS

The first treatment unit, the storage lagoon for the caustic waste, is probably the most important and is the key to the successful operation of the treatment plant. The lagoon enables us to control the pH through the plant on a full seven-day basis. It also converts about 65% of the hydroxide alkalinity to the carbonate or bicarbonate form. A reduction of 15% in BOD is also accomplished in the lagoon. No appreciable drop in pH occurs in the lagoon. Odors are no problem as long as the pH is maintained between 11.0 and 12.0.

The second treatment unit, primary settling tanks, were designed so that segregation or any combination of wastes can be maintained through the primary tanks. control of the flow can be regulated from recirculation pumps. This is necessary for the early hours of the morning and for weekend operations. The best operation has resulted when the starch waste is settled separately. It is necessary to control the pH of the starch waste in order to prevent fermentation in the primary settling tanks. At first this was done with caustic waste, but this method greatly reduced the volume of sludge from the primary settling tanks. This in turn increased the biological loading to the filters. The addition of lime for pH control resulted in much better sludge removal and better filter operation. The caustic waste is blended with the incoming domestic sewage and slasher waste. The remaining hydroxide alkalinity is converted into carbonate or bicarbonate as it passes through the primary settling tanks.

The third treatment unit, two-stage trickling filters, consist of one roughing filter, 150 feet in diameter with an average depth of six feet. The filter media is crushed stone of two- to four-inch size. This filter is operated at a constant flow of 9.0 mgd or 22.17 mgad. This is accomplished by having the effluent from both the primary settling tanks and the filter discharging into the pump pit. The arrangement is such that all of the primary settling tank effluent goes to the

pumps, and after the flow is built up through the filter the overflow goes to the secondary filters by gravity. The recirculation rate on the roughing filter varies from a minimum of 3 to 1 to much higher rates on the week-ends.

The secondary filters are the two low-rate filters that were converted to high rate. The flow rate was designed for 15.07 mgad and some difficulty with filter flies was encountered last summer. Additional recirculation pumps have been installed and that rate can now be regulated up to 28.0 mgad.

The fourth treatment unit, secondary settling tanks. are of conventional design. The flow rate can be maintained by regulating the recirculation pumps. This is necessary in order to maintain flows over the week-ends and at other periods of low flow. A large volume of sludge is drawn continuously and pumped back to the head of the plant where it is settled again and pumped to the digestors.

The fifth treatment unit, chlorine contact tank, is used only during the summer months. A chlorine dosage of up to 3000 pounds per day can be applied. The condition of the receiving stream governs the amount of chlorine added. Stream samples are taken during the summer months and the results of these tests determine the chlorine dosage.

The sixth treatment unit, sludge digestors, are operated on a fill and draw method. The primary sludge contains a very high percentage of corn starch and ferments very rapidly. For this reason, a batch method of operation is best. It usually requires about 24 hours to fill a digestor and then 48 hours of rest in order to complete the gas production. A good quality of supernatant can then be drawn. Digested sludge is drawn from each digestor on a weekly schedule to a storage pit. The supernatant can be pumped back to the head of the plant, to the secondary settling tanks or to the sludge drying beds. It can be chlorinated when necessary. The digested sludge is vacuum filtered on a Komline-Sanderson Coil Filter and used for fertilizer.

RESULTS

The plant was placed in full operation in June 1956. Several operating difficulties were encountered and modification of treatment methods were necessary to obtain the desired operating efficiencies.

The temperature of the waste and the atmosphere are nearly the same for about 60% of the time during the hot summer months. This condition caused very poor natural ventilation and depleted the oxygen in the waste before it passed through the roughing filter. With the anerobic conditions in the bottom of the filter, very foul odors were exhausted at night, when proper ventilation did take place. This condition existed during the summer of 1956. Several of the odor masking chemicals were tried and all were unsuccessful. During the winter months when there was adequate ventilation no odor problem existed. A slight modification of the filter was made and four fans, blowing directly into the under drain system of the filter, were installed. This completely eliminated the odor problem and increased the efficiency of the roughing filter by about 30%.

The operating results of the plant are very satisfactory. February 1957 results show an average pH coming into the plant of 11.8 and a BOD of 1389 ppm. The percent removal of BOD through the plant was 82.6 and the settleable solids was 99.9. This operation was without the addition of any chlorine.

August 1957 results show an average pH coming into the plant of 11.4 and a BOD of 1390 ppm. The percent removal of BOD through the plant was 95.3 and the settleable solids was 98.3. Chlorine was added during this period at the rate of approximately 110 ppm.

The combined waste being treated through this plant is about 60% textile waste and 40% domestic sewage.

The flexibility of operation and the control measures available to the operator are the chief features of this plant. In many plants the operation is fixed and no control measures are provided. Here, we have control of the flow rates, the pH, and the biological loading. Corrective measures can be made by the operators when necessary. This results in much better operation and consistent efficiencies are maintained.

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Treatment of Mixtures——

(*concluded from page P488*)

removal and reduce hydroxide alkalinity during the regular lagooning period.

H) Chemical treatment is normally too expensive. It should be used only when biological treatment is not practical or economical.

I) The amount of textile waste that can be treated without pretreatment is limited only by the amount of hydroxide alkalinity, rather than the pH of the mixed wastes.

EXPERIMENTS IN PROGRESS ——Field experiments are being continued on lagooning of mill waste with and without seeded sewage, to determine effect in reduction of BOD, color and alkalinity. Experiments are also in progress to determine the effect of aeration during the lagooning period.

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Pollution Control———

(*concluded from page P479*)

recent years. In the New England Compact area, over $150 million has been expended on municipal sewage treatment plants in the past eight years, and with 30% construction grants now available under Public Law 660, municipal facilities are being installed at an accelerated rate. Industry in the New England area has not, to date, assumed its rightful role in the picture. Of particular concern to the States and the Commission is the apparent lack of interest displayed by textile mills in pollution reduction through process chemical changes. The mills fail to realize that the textile industry is the only one which can effectively reduce pollution in this manner. All other industries are faced with the cost of installing substantial treatment works to reduce their pollution to any degree.

CONCLUSION

It is hoped that the American Association of Textile Chemists and Colorists will urge the textile industry and individual mills to investigate and use the reduction methods now available. This probably could be accomplished most effectively by AATCC establishing a full-time advisory and research group similar to the organizations sponsored by other industries. Such a group would be of material assistance to individual mills in solving pollution problems and in continuing research on process chemical substitution and other means of pollution control.

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H Haley Ector—Tech sales rep, A E Staley Mfg Co, Atlanta, Ga. Sponsors: W N Dulaney, J C Cook. (SE).

Ralph M Greene—Textile technologist, U S Government General Services Administration, Washington, DC. Sponsors: R M Gregg, R L Ward. (W).

Tokiharu Narita—Director of textile research, Institute of Japanese Government, Yokohoma, Japan. Sponsors: G J Mandikos, H W Stiegler.

Fernando B Olvera—Asst chemist, Acabados Textiles Lourdes, SA, Mexico. Sponsors: G A Billingsley, R C Squier.

Barney E Sampson—Lab mgr, American Finishing Co, Memphis, Tenn. Sponsors: J P Duffy, H G Smith. (SCl).

ASSOCIATE

Etta L Finley—Assistant professor, Louisiana State Univ, University Station, Baton Rouge, La. (SE).

Duck Soo Kim—Dyestuffs & chemicals sales engineer, Donkook Industrial Co, Ltd, Seoul, Korea.

Alice C Linn—Extension clothing specialist, Federal Extension Service, U S Dept of Agriculture, Washington, DC. (W).

Marion A Pool—Southern sales mgr, Johnson Motor Lines, Inc, Charlotte, NC. (Pied).

Margaret L Ross—Director, School of Home Economics, Simmons College, Boston, Mass. (NNE).

Brannon H Wilder — Salesman, Tennessee Corp, Atlanta, Ga. (MW).

STUDENT

Miguel S Marina—Pasante de Ingenieria Textil, Instituo Politecnico Nacional, Mexico.

Shirish B Mehta—Student, Lowell Technological Institute, Lowell, Mass. Sponsor: G R Griffin. (LTI).

Armando Munoz—Student, Escuela Superior de Ingenieria Textil, Mexico.

TRANSFER TO SENIOR

John D Egan Jr—Tech service rep, E I duPont de Nemours & Co, Inc, Wynnewood, Pa. Sponsors: T E Bell, R P S Black. (DV).

Adeline M Hoffman—Chairman, Dept of Clothing & Textiles, School of Home Economics, Southern Illinois Univ, Carbondale, Ill. Sponsors: R P Dowlen, R L Ward. (MW).

Edward L Kelley—Tech service rep, Verona Dyestuffs Co, Union, NJ. Sponsors: C W Shain, M Frankfort. (Met).

Betty Faye Smith—Graduate teching assistant, Univ of Minnesota, St Paul, Minn. Sponsors: S Davison, M M Cooper. (MW).

Elected to Membership

JUNE 19, 1958

SENIOR

Richard E Davies
William H Greene
Rudolph Jesel
David R Lassiter
Harold Roberts
Jack A Roddy
Alex F Salerno
John Sauls
Nicholas Vlachos
Frank R Wean

ASSOCIATE

William P Anderson
Ruth W Ayres
Virginia Davis
Sarah L Hawes
Alfred Hopton
Ruth E Knoch
William S Ward
Frank D Lemma
Eunice M Martin
Sister Mary Claudine
Ramanal Panchal
Stella B Schulz
Thelma L Thompson

JUNIOR

William P Gibert

STUDENT

Eleanor Chenault
I H Thaker

TRANSFER TO SENIOR

James G Wylie
Sherman Lein

ACTIVITIES OF THE LOCAL SECTIONS

South Central

APPROXIMATELY 225 persons registered for the 1958 Summer Outing of the South Central Section, held May 30-31 at Gatlinburg, Tenn. Headquarters for the outing was The Hotel Greystone, with Jack McNab, Mac Chemical Co, serving as chairman.

The program on Friday evening included a cocktail hour on the hotel lawn, followed by buffet dinner in the Greystone Playhouse and bingo.

Saturday's activities included the men's golf tournament at the Gatlinburg Country Club; ladies luncheon followed immediately by bridge and canasta in the Greystone Playhouse at noon; horseshoes and bait casting in the afternoon; cocktail party on the lawn, banquet, and a semi-formal dance in the evening.

Gordon Eaves, Cloverdale Mills, shot a 76 in the golf tournament to take low gross honors for mill men. He was awarded the silver cup donated by the Mac Chemical Co and a wrist watch.

Howard Cardwell, Cherokee Textile Mills, took top honors in the bait-casting event.

In horseshoe pitching, Fred M Price, Sweetwater Hosiery Mills, won the singles event; while the team of Philip Stevenson, Belcraft Laundry, Inc, and Francis X Minich, Metro-Atlantic, Inc, took top honors in the doubles.

Mrs Jack McNab served as chairman of the ladies activities, aided by Mrs W T Evans and Mrs James I Wright. In the ladies events, Mrs W D Blackman Jr won in bridge, while Mrs W S McNab won in canasta.

Western New England

ON Friday, June 13, 1958, the Western New England Section held its 11th Annual Outing at the Wallingford Country Club, Wallingford, Conn. Approximately 60 members and guests enjoyed a day of golf and other sporting events.

As is usual at WNE Section outings, everyone attending received a prize.

South Central Section Outing
May 30-31, 1958 • Gatlinburg, Tenn

HEAD TABLE (l to r): Mr & Mrs Ed Jurczak, SC Section secretary; Mrs & Mr Jack Anderson, SC Section councilor; Mrs & Mr Jack McNab, outing chairman; Mr & Mrs E V Helms, SC Section chairman; Mr & Mrs J D Mosheim; Mr & Mrs H Gillespie Smith, AATCC vice president, Southern Region; Mr & Mrs Bob Ingram, SC Section treasurer

Delaware Valley

A ATCC officers and members who attended the recent national meetings in Philadelphia were able to attend the Delaware Valley Section's 1958 Outing at the Torresdale-Frankford Country Club on May 23rd.

The outing, under the chairmanship of A E Raimo, John Campbell & Co, Inc, attracted its usual large turnout in ideal weather.

Assisting Mr Raimo were the following: *golf*—W W Gleadall, Textile Chemical Co; *darts, cards, quoits*—L R Croce; *prizes*—J M Jester Jr, Amalgamated Chemical Corp; *dining*—C P Hoffner, Hoffner Rayon Co; *savings bond sales*—J W Huber, Onyx Oil & Chemical Co; *reservations*—Ernst W Empting, Verona Dyestuffs; *finance*—C A Seibert, Scholler Bros; *printing*—D W Robinson, Para Chem, Inc; *publicity*—G C Wunsch, North American Lace Co; *entertainment*—L Kevin McChesney, Leatex Chemical Co.

Metropolitan

OVER 450 members and guests attended the annual outing and golf tournament of the Metropolitan Section on June 6th at the North Jersey Country Club, Wayne Township, NJ, making the affair the largest ever to be held by the Section. More than 200 participated in the golf tournament.

Chairman in charge of the outing was Michael F Costello of Jacques Wolf & Co, with a committee consisting of Hugh J Bonino, Metro-Atlantic, Inc; Chris W Farrell, Althouse Chemical Co; Eugene J Grady, Jacques Wolf & Co; Gerard Heine, Koppers Co; Richard P Monsaert Jr, Puritan Piece Dye Works; and Jack M Schandler, Rohm & Haas Co.

The golf tournament featured a tie for low gross, with Martin E Mangarelli, Franklin Finishing Co, and Robert W Brewer, Koppers Co, carding 76s. Mr Mangarelli was the winner by matching cards. Edwin G Frick, Allied Textile Printers, Inc, was third with a 77, and Richard L Jones, Royce Chemical Co, was fourth with 78.

Low net honors were taken by Herbert Marzell, E I duPont de Nemours & Co, Inc, with a net of 67. George Maynard, Warwick Chemical Div, was second with a 68; Herman Moeller, Du Pont, third with a 69; and Raymond J Cote, Steinfeld Fabrics, fourth with a 70.

The putting contest was won by Chris W Farrell.

The annual Martin Weiner Co fashion plate award for the brightest printed sport shirt was won by P J Wood, Royce Chemical Co.

A special award was presented to Robert F Holoch in appreciation of his 35 years service as chairman of the horseshoe pitching contests at the outing.

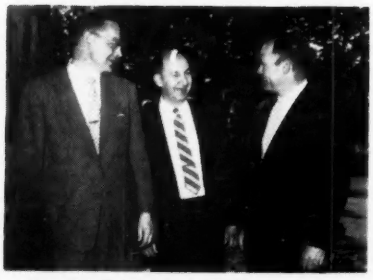
Because of the popularity of this outing, a motion was put forward to investigate the possibilities of holding a fall outing or placing restrictions on the spring outing, as many members have been unable to procure tickets.

(*Photos on page P495*)

Delaware Valley Section Outing
May 23, 1958 • Torresdale-Frankford Country Club, Philadelphia, Pa

(All captions read left to right)

Walter W Gleadall, golf chairman; Ed Smith, low gross winner; William S Sollenberger, DV Section chairman



Donald E Marnon, chairman & councilor, Metropolitan Section; Thomas H Hart, DV Section councilor; Richard P Mosaert Jr, secretary & councilor, Metropolitan Section

Walter W Gleadall, golf chairman; Carter Ferguson, low net winner; William S Sollenberger, DV Section chairman

Clarence A Seibert, treasurer & councilor, DV Section; Donald W Robinson, councilor, DV Section; George O Linberg, AATCC president; Weldon G Helmus, AATCC vice president, Central Atlantic Region

Arthur M Gordon; George G Wunsch, DV Section publicity chairman; A L Raimo, outing chairman; W Morlock; I Arthur

Metropolitan Section Outing

June 6, 1958

North Jersey Country Club, Wayne Twsp, NJ

(Photos by Louis J Dogin)

P J Wood (left) receives fashion plate award for the outstanding sport shirt from Outing Chairman Costello as Charles Minoff, Texstyle Corp, award donor, looks on.

Some of the Metropolitan Section's "brass" l to r: Richard P Monsaert Jr, secretary; Weldon G Helmus, national vice president and member of the Section's Executive Committee, John H Hennessey, member, Executive Committee; Brendan F Quigley, Max W Winkler, and Arthur J Kellner, national councilors representing the Metropolitan Section.

The "reception committee" at the outing: l to r: Eugene F Grady, Jacques Wolf & Co, Michael F Costello, Jacques Wolf & Co, outing chairman; Gerard Heine, Koppers Co.

L to r: Martin F Mangarelli, low gross winner; Michael F Costello, Jack M Schandler, and Chris W Farrell.

Robert F Holoch (left) receives trophy from Outing Chairman Michael F Costello in recognition of his 35 years' service as chairman of the horsehoe pitching contest.

Partial view of large gathering at dinner

Mid-West

THE Mid-West Section held its last meeting of the season on June 14, 1958 in conjunction with its 26th Annual Outing at Browns Lake Resort, Burlington, Wis.

Outing activities began on Friday, June 13th, with a two-ball foursome golf tournament in the afternoon.

Saturday's schedule called for golf and softball in the morning, and horseshoes and shuffleboard in the afternoon.

A cocktail party preceded the banquet and awards in the evening.

Chairman for this year's outing was Roger G Carr, Geigy Dyestuffs. He was assisted by George Chabot, R R Blank, Jerry Frericks, C J Kurowski, William Paine, Victor Braun, Archie Alexander, Otto Grulke, George Willgeroth, James Whalen, William Fischer, and Frank Gurry.

The business meeting was called to order with 119 members and guests present. John Eich, chairman of the Nominating Committee, nominated the present officers for another term in office. He also nominated Edwin I Stearns for councilor to replace J G Stott, who has completed three years in the office. The nominations were voted on and passed.

Because of decline in attendance at recent meetings in Cincinnati, it was voted to hold the Section's 1959 Spring meeting in Milwaukee. Next year's outing will again be held at Browns Lake Resort, and arrangements have been made with the nearby Waterford Golf Course.

AATCC Calendar

COUNCIL

Sept 19 (Charlotte, NC); October 30 (Conrad Hilton Hotel, Chicago, Ill); May 1959 (Montreal, Canada)

NATIONAL CONVENTIONS

Oct 30-Nov 1, 1958 (Hotel Conrad Hilton, Chicago); Oct 8-10, 1959 (Sheraton Park and Shoreham Hotels, Washington, DC); Oct 6-8, 1960 (Sheraton Hotel, Philadelphia, Pa); September 28-30, 1961 (Buffalo, NY); 1962 (Southern Region)

DELAWARE VALLEY SECTION

Sept 12 (Wilmington Meeting), Oct 17, Dec 5

NIAGARA FRONTIER SECTION

Sept 26 (Niagara Falls, Ont); Oct 24 (joint meeting with CATCC at St Catherines, Ont); Dec 5 (Buffalo, NY); Feb 20 (Niagara Falls, Ont); April 4 (Hamilton, Ont—joint meeting with CATCC)

NORTHERN NEW ENGLAND SECTION

Sept 12 (Outing—Wachusett Country Club, West Boylston, Mass); Oct 17 (QM Research & Development Ctr, Natick, Mass); Dec 5 (Hotel Vendome, Boston, Mass); Jan 16 (Colonial Club, Lynnfield, Mass)

PIEDMONT SECTION

Sept 19-20 (Hotel Charlotte, Charlotte, NC)

RHODE ISLAND SECTION

Sept 26 (Management Night — Warwick Country Club); Oct 23 (Providence Engineering Society); Dec 4 (Annual Meeting—Johnson's Hummocks Grille, Providence)

SOUTH CENTRAL SECTION

Sept 13 (Hotel Patten, Chattanooga, Tenn)

SOUTHEASTERN SECTION

Sept 13 (Ida Cason Callaway Gardens, Chipley, Ga); Dec 6 (Atlanta, Ga)

WESTERN NEW ENGLAND SECTION

Sept 26 (Hartford, Conn); Oct 24 (Annual Meeting—Rapp's Restaurant, Shelton, Conn; Dec 5 (Rapp's Restaurant, Shelton, Conn)

Future Papers

The following material has been submitted to date to the publishers of American Dyestuff Reporter. Subject to the approval of the AATCC Publications Committee, it will appear in the Proceedings in future issues.

Authors, section officials, and committee chairmen are required to inspect this list and notify the publishers if there are any omissions.

"The Mechanism of Dyeing Orlon 42 Acrylic Fiber"—T Vogel, J M A deBruyne and C L Zimmerman, American Cyanamid Co

"Practical Emulsions" — Paul Becher, Atlas Powder Co, Inc

"Recent Developments in the Chemical Finishing of Textiles", Fred Fortess, Celanese Corp of America

"Wash-Wear Resins for White Cotton Fabrics"—Hector C Borghetty, Rohm & Haas Co

"Nylon Carpet—Growth and Technology"—Graham C Richardson, E I duPont de Nemours & Co, Inc

"Dyeing Darvan Dinitrile Fiber"—Helen G Sommar, B F Goodrich Chemical Co

"The Continuous Dyeing of Synthetic Fibers and Blends"—J J Iannarone and W J Wygand, E I duPont de Nemours & Co, Inc

AATCC SUBJECT AND SPEAKERS BUREAU

The Subject and Speakers Bureau Committee of AATCC is now soliciting additional papers to augment its current file of available subjects and speakers.

Quarterly, a listing of these subjects is circulated to all local sections of AATCC, with an invitation to local section program chairmen to contact the speakers for section meetings. This file now consists of more than 50 subjects, and many sections have benefited from this service.

Those who have papers ready or in the process of preparation are invited to submit an abstract of the paper to the chairman or other members of the Committee.

Papers of a general nature, as well as technical papers, will be acceptable.

SUBJECT AND SPEAKERS BUREAU COMMITTEE

Mathew J Babey, *chairman*
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Bound Brook, NJ

Richard R Frey
AATCC Headquarters
P O Box 28
Lowell, Mass

Charles A Whitehead
American Dyestuff Reporter
44 East 23rd St
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Further Particulars from

American Association of Textile Chemists and Colorists

PO Box 28, Lowell, Massachusetts

News of the Trade

American-Marietta Acquires Sodyeco

American-Marietta Co, Chicago, Ill, has become a major producer in the dyestuffs industry through its recent acquisition of the business of Southern Dyestuff Corp. Officials of the two firms consumated the transaction at Charlotte, NC. The transaction was approved by Southern Dyestuff shareowners on June 30th.

Principal business of Sodyeco is the supplying of vat, sulfur and pigment dyes to many segments of the textile industry in the U S, Canada and other textile-producing countries.

This new acquisition strengthens American-Marietta's position in the production of basic end products of chemical research, and in world marketing. Sodyeco, which has numerous active patents in the U S and in most dyestuff-producing countries of the world, recently purchased a 50% interest in the largest sulfur dye producer in Central and South America, Naegeli, S A of Rio de Janeiro, Brazil.

Sales of Sodyeco reportedly have tripled since 1952 and show a 15% increase for the current fiscal year, which ended on June 30th.

ASTM Holds Session on Textiles at Annual Meeting

The collection and use of data in the textile manufacturing industry was discussed at the session on textiles held at the ASTM Annual Meeting, Boston, June 22-27. The session was held following the Annual President's Luncheon at which the Society's retiring president, Richard T Kropf, vice president and director of research, Belding Heminway Co, Inc, presented his annual address.

In a paper entitled "Data Under Difficulties," E R Schwarz of the Massachusetts Institute of Technology discussed the laboratory problems faced in obtaining data under circumstances which make adequate observations imperfect or impossible. He discussed these in terms of demonstration and examples and pointed out the importance of the trained observer in testing and research.

A second paper with a similar title, "Difficulties with Data," was presented by Kenneth Fox and Richard Wells of Fabric Research Laboratories, Inc. Their presentation outlined the problems of utilizing data as related to production, cost, quality, efficiency, and other practical mill and commercial considerations.

Cotton Wash-Wear Finish Under Test for Use by Local Drycleaners

Wash-wear finishes for cotton garments, designed for application by local drycleaners, have been developed by scientists of the US Department of Agriculture and the drycleaning industry.

Chemists of the National Institute of Drycleaning at Silver Spring, Md, working with USDA's Agricultural Research Service, are now testing several crease-holding, wrinkle-resisting resin finishes, which can be applied to cotton garments with standard drycleaning equipment.

The most promising of the new finishes under study by USDA and industry workers reportedly has given good results in preliminary tests. It has shown good ability to hold pressed-in creases as well as to resist unwanted wrinkles. This finish can be applied to garments after they are made.

The process consists of wetting the garment in a resin solution (containing a thermosetting resin, a thermoplastic resin, a silicone emulsion, two catalysts, and a surface-active agent), then shaping, pressing, drying, and curing the resin finish in a single operation, and after-curing in a hot-air cabinet. Finally the garment is washed and tumble-dried before delivery to the owner.

Because of the need for closely controlling conditions under which the fabric is treated, the process is not suitable for application by the housewife.

The finish will not last the life of the garment, but on the basis of cost studies, USDA scientists believe the treatment will be inexpensive enough to justify renewal.

Amalgamated-Southern Changes Name

The name of Amalgamated-Southern, Inc, Greensboro, NC, has been changed to Cindet Chemicals, Inc, in keeping with the fact that the firm is no longer associated with any other company.

Cindet Chemicals, Inc, will continue to manufacture a broad line of textile chemical specialties at its plant on High Point Rd at Sedgefield, Greensboro.

President of the firm is Robert A Bruce, who is one of the founders of Amalgamated Chemical Corp of Philadelphia, Pa.

International Committee on Detergents Formed

Following the constitution of the provisional Comité International de la Détergence (International Committee on Detergents) during the 2nd International Congress on Surface Activity in London in April 1957, a meeting of some fifty French and foreign delegates was held in Paris on April 15, 1958.

During the day's work, the Comité International de la Détergence (CID) was definitely formed.

Following invitations sent out by the Comité Français de la Détergence, the chairman of which is Léon Duverger, also president of the Chambre Syndicale Tramagras, the delegates of the Committees on Detergents of the following countries unanimously voted the bylaws of the CID: Belgium, France, West Germany, Greece, the Netherlands, Spain, and Switzerland.

The following were excused: Austria, Denmark, Israel, Italy, and Poland.

In addition, Committees on Detergents are being organized in Argentina, Japan, Portugal, the United Kingdom, and the USA.

The CID intends to work in close collaboration with such international bodies as ISO (International Organization for Standardization), IUPAC (International Union of Pure and Applied Chemistry), etc, and has set as its prime purpose the preparation of international standardization in the fields of terminology, analysis and testing methods.

With this in view, three technical international commissions have begun to work, under the chairmanship of specialists, who, on 15th April, gave an account of what had been achieved so far.

After voting to accept its proposed bylaws and budget, the CID elected Mr Duverger president. Walter Hagge, president of the German Committee on Detergents, was elected vice president. Both were elected unanimously.

The CID, which, among other things, undertakes the organization of World Congresses on Surface Activity, will hold the next one in Western Germany, in 1960. It will be organized by the German Committee on Detergents.

The Secretariat of the CID is located at 70 Champs-Elysées, Paris (8°), France.

DuPont Opens New Pigments-Electrochemicals Service Lab

A new $5 million laboratory to provide service to customers and for evaluation of new or improved products of its Electrochemicals and Pigments departments has been opened by the Du Pont Company at Chestnut Run, Pa.

Although some facilities are shared jointly by the two departments, the building houses separate laboratories for product development in the textile, paper, plastics, ink, metals, and allied chemical fields.

[In connection with the opening, the Du Pont Company announced the development of a new family of red pigments, the Monastrals.

For both departments, the laboratory provides a center for research work on problems of customers, for customer visits, development work on new products and new uses for established products and training of field technical representatives. Sales service facilities for the Electrochemicals Department formerly were maintained at its Niagara Falls plant. Prior to the completion of the new building, the Pigments Department operated separate service laboratories at Newark, NJ, and at its Newport, Del, plant.

The laboratory contains 8,000 square feet of floor space, including 150 separate rooms, laboratories, and demonstration areas. The technically trained staff of 130 includes chemists, chemical engineers, metallurgists, and other specialists.

The Electrochemicals wing, on one floor, contains equipment for duplicating customer operations in the sodium, peroxygen, chlorine, vinyl, and related product fields.

The Pigments laboratory occupies two floors and has facilities for developing tailor-made pigments. In addition, there are complete technical service facilities for titanium, silicon, and niobium, also made by the Pigments Department.

The Pigments area contains 40 laboratory and testing rooms. Other areas contain ball mill and roller grinding, spraying, accelerated weather testing, and oven-baking equipment. Special equipment includes a textile spinning machine for processing of mass pigmented fibers, plastics extruder, roofing granule machinery, rubber mills, paper making and calendering, and a printing press.

Other facilities determine pigment performance under controlled conditions. An indoor test room, with a 50-foot glass wall, provides uniform northern exposure for test panels. Outdoor test panels are prepared in another area and installed at the nearby test farm.

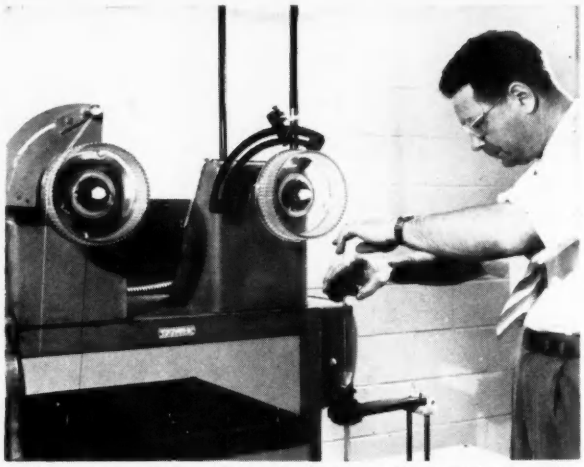
An important laboratory function will be to develop pigment formulations for customer use. This includes evaluation as to stability in storage, ease of application, appearance, and durability.

The Electrochemicals wing is divided into four major product areas—peroxygen, vinyl, sodium, and chlorine. Seventeen individual laboratories are grouped around large demonstration areas in which there is extensive equipment which duplicates customers' operations on a semi-works scale.

In the peroxygen area, latest equipment is available for bleaching textiles, paper, and other products. Another area is devoted to polyvinyl alcohol and polyvinyl acetate.

Maximum use of color and many products of both departments have been incorporated in the building. In the Pigments wing, walls and floor tiles of various colors are used to distinguish the separate work areas. The lunch room and conference room in the Electrochemicals wing are panelled with porcelain-coated aluminum tiles.

The red brick and steel frame structure is similiar architecturally to other sales development laboratories on the Chestnut Run site, operated by the company's Textile Fibers, Polychemicals, and Film departments and one operated jointly by the Elastomer Chemicals and Organic Chemicals departments.



Mass pigmentation of textile fibers at Du Pont's new Pigments Sales Service Laboratory. Here single-end spinning machine is used for making viscose rayon pigmented with a new Monastral red. In this technique, color is put into the yarn instead of applied to the surface.

Textile research at Du Pont's new Pigments Sales Service Laboratory. Here a technical service representative winds pigmented acetate fiber on mirror cards. They are used for color comparisons and for sample books. Du Pont color pigments are used in solution-pigmented acetate, rayon and other man-made fibers for lightfast coloration.

Bleaching of fabrics at Du Pont's new Electrochemicals Sales Service Laboratory. Here results of a Launder-Ometer-accelerated washing test are being checked. Bottles are pre-heated in rack at right. Bleach and textile samples are added just before bottles are transferred for washing.

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A D Little Completes Textile Education Survey

Arthur D Little, Inc, industrial research company of Cambridge, Mass, has submitted its final report, "Preliminary Survey of Textile Education," to the National Council for Textile Education. NCTE asked the Cambridge firm to help assess the needs of the industry that the colleges offering collegiate-level instruction in textiles could remedy by training and educating its future personnel.

Alarmed by the public attitude toward the textile industry and its effect on the unique industrial educational centers represented on the NCTE, the Council sought outside evaluation of the professional preparation offered by the textile colleges and of the opportunities for their graduates in the textile industry. A D Little, Inc, conducted a survey among the colleges, their over 20,000 graduates, and industry leaders, the first such study since the Feiker report to the Textile Foundation in 1934.

The new survey appears to show that industry personnel "must be prepared to assume broader responsibilities . . . to progress to the higher executive levels," and the "major emphasis of their training should be in fundamentals rather than in specialization" to do this. Traditional textile college curricula have emphasized specialized vocational courses. The Little report urges expansion of the present trend toward "basic principles of engineering and science" and more liberal arts and management courses with consideration of only the fundamentals of textile science and technology.

Contrary to general opinion, opportunities for textile graduates are promising, according to the survey, and will continue to increase. Among the alumni, 60 percent of the BS degree-holders remain in the industry, and 23 percent go into textile-related industries. The ultimate annual compensation of textile college graduates is apparently as high or higher than that of the major types of engineering graduates. However, initial annual income is less than that of the other engineers.

The study appears to give reassurance to those textile colleges which began to revise their curricula a few years ago in an effort to fulfill their obligations of providing well-trained manpower and leadership to the industry by emphasizing technological and scientific fundamentals and broader training in the liberal arts.

The following institutions are represented on the National Council for Textile Education (dates in parentheses indicate year of establishment of textile courses): Philadelphia Textile Institute (1884), Lowell Technological Institute (1897), Clemson Agricultural College (1898), New Bedford Institute of Technology (1899), Georgia Institute of Technology (1899), North Carolina State College (1899), Rhode Island School of Design (1903), Bradford Durfee College of Technology (1904), Texas Technological College (1925), and Alabama Polytechnic Institute (1929).

PTI Graduates 81

Sixty-nine BS degrees, eight diplomas, and four certificates of proficiency were awarded to eighty-one students from the United States and abroad at the 74th Commencement exercises of the Philadelphia Textile Institute, held June 7th at the Institute campus.

Seventeen seniors were awarded BS degrees in chemistry and dyeing, and 52 received BS degrees in textile engineering. Two diplomas in technology of knitting and six in technology of textiles were awarded to students who had completed the 3-year courses. Four certificates of proficiency were awarded for completion of the six-year evening school courses, two in chemistry and dyeing and two in textiles.

Principal speaker at the exercises was J Spencer Love, chairman of the board and president, Burlington Industries, Inc, who was conferred with the honorary degree, Doctor of Textiles, by Bertrand W Hayward, PTI president.

Dr Hayward also conferred honorary degrees upon M Earl Heard, vice president in charge of research, West Point Mfg Co (Doctor of Textile Science); W Lyle Holmes, president, Archibald Holmes & Sons, Inc (Doctor of Textiles); and William J Lane, Pennsylvania State Senate (Doctor of Humane Letters).

Bertrand W Hayward (left), president, Philadelphia Textile Institute, congratulates J Spencer Love, board chairman and president, Burlington Industries, recipient of the honorary degree, Doctor of Textiles, and principal speaker at 74th Commencement Exercises of the Institute.

A Ward France, dean of faculty at PTI, presented the candidates for graduation, and the degrees were conferred by President Hayward.

Donald B Partridge, PTI dean of students, presented the following award winners:

AATCC Prize—Charles B DeGreen

AATT Prize—Edward W Harris

Textile Veterans Association Honor Medallion—Donald Stogo

Edward W France Memorial Citizenship Award—Frank Scardino

Fraternity Prizes—Thomas C Cox (Phi Psi); Saverio Russo (Delta Kappa Phi); Alfred Sussman (Sigma Phi Tau)

Mrs George Cavendish, granddaughter of Sara Tyler Wister, presented the Sara Tyler Wister awards for students with the highest academic standing for the full length of their respective courses. In the chemistry and dyeing course, Charles B DeGreen was awarded 1st prize, and Thomas C Cox, 2nd prize.

73 Receive Textile Degrees at LTI, First Plastics Engineering Degrees Granted

The Lowell Technological Institute awarded degrees to a graduating class of 115 during its 60th annual commencement exercises on June 15th, with 73 students receiving degrees in textiles or chemistry.

Highlighting the exercises was the granting of the country's first BS degrees in plastics engineering, as eight men completed the course instituted in 1954.

Martin J Lydon, president, conferred the degrees and awarded the honorary degree of doctor of science to Assistant Secretary of Defense E Perkins McGuire, former trustee and 1928 alumnus of LTI, who was commencement speaker, and Philip S Marden, author and publisher.

Of the 73 students who received textile degrees, four received the MS in textile chemistry, and four received the MS in textile engineering. Sixty-nine BS degrees were awarded as follows: 17 in textile chemistry, 35 in textile engineering, nine in textile technology, and five in textile sales and management.

Receiving graduation prizes were Philip E Swanson (AATT award, the President's medal, and the Dean's key); W Preston Cooper (NTA Cotton Medal and Textile Veterans Association award); and C William Rowntree (Phi Psi award).

Linberg, Leonard, Clayton Honored at LTI Alumni Reunion

George O Linberg, Synthron, Inc; Bryon Leonard, East Weymouth Wool Scouring Co; and Harold E Clayton, Clayton Hosiery Mills, were honored by alumni of Lowell Technological Institute at the 59th annual reunion, held May 24 at Lowell, Mass.

Mr Linberg, president of AATCC, was awarded Honorary Membership in the LTI Alumni Association. Messrs Leonard and Clayton, who are LTI alumni, received Honorary Awards. LTI Alumni President Clifford Harvey, Vertipile, Inc, made the presentation during the annual business meeting.

Other highlights of the Reunion, of which Robert E Morrison of the LTI faculty and Edward M Lynch of The Derby Co, Inc, were cochairmen, included the luncheon, at which LTI seniors are guests of the Alumni Association; a baseball game between LTI and the University of New Hampshire; guided tours of the LTI Plastics Laboratory; an exhibit of LTI Archives; and the traditional social hour and annual banquet at the Andover Country Club.

Canadian Textile Conference Huge Success

Delegates from all over Canada gathered in Montreal's Queen Elizabeth Hotel recently for an event unique in world textile history. With "a place for all," the Canadian Textile Conference is believed to have been the first gathering of its type ever held.

More than 800 men and women representatives of the vast Canadian primary textile industry registered for the business sessions, and it is estimated that some 5,000 people saw the mammoth fashion shows scattered throughout the three days.

More than a year in the planning, the Conference covered almost every phase of textile industry business with more than 30 speakers, many of national and international fame. Two separate programs were arranged to provide the ladies with alternate events during the more technical business sessions.

The Conference was organized entirely by the primary textile industry and its member groups and was designed to attract technicians, designers, marketing experts, economists, accountants, management, etc. At the same time the program included a place for chemical suppliers, garment manufacturers, retailers and consumers.

Zelomek Declares Outlook Good at TDI Meeting

Speaking at the Annual Meeting of the Textile Distributors Institute, Inc, last month, A W Zelomek, president of the International Statistical Bureau, Inc, presented an encouraging report for the future in his address "The Outlook for the Rest of the Year," with emphasis on textiles and apparel.

TDI's retiring president, Walter Ross, president of Rosewood Fabrics, Inc, was elected chairman of the board.

Mr Ross is succeeded in the presidency by Nat Leavy, of Goldstein & Leavy, Inc. Elected vice presidents are Irving Roaman, Reliable Textile Co, Inc; Louis E Kates, French Fabrics Corp; Louis J Brenner, Shirley Fabrics Corp; and James P Marion Jr, Bloomsburg Mills, Inc. Ira Jacobson, Cohn-Hall-Marx Co, was elected treasurer, and Hilda Wiedenfeld continues as executive director.

Jackson A Spears, Burlington Industries, Inc, chairman of the Nominating Committee, offered a slate of 23 candidates, who were elected to the board of directors.

Preceding the annual meeting, a special meeting of the board of directors voted on various amendments to the constitution, including a provision for Associate Membership. Previously this provision remained undefined.

Emkay Names New Agency

Emkay Chemical Co, Elizabeth, NJ, has named Gordon-Pilling, Inc, 90 Broadway, Paterson 1, NJ, as its advertising agency.

Elvanol Price Reductions

The Du Pont Company last month announced price reductions ranging from four and one-half to 15 percent on five major grades of Elvanol polyvinyl alcohol in a move to broaden markets for the product.

The reduction of 10 cents per pound on Elvanol 72-60, which is used for textile sizes, brings the new price to 57 cents a pound.

Prices of Elvanol 50-42 and 52-22, used in the manufacture of polyvinyl acetate emulsions, were reduced five cents a pound, making the new prices 83 cents and 75 cents a pound respectively. Prices of Elvanol 71-30, used for unsupported transparent film, and Elvanol 51-05, used for textile sizes, were dropped three cents a pound. The new price for both is 64 cents a pound.

Ontario Section, CATCC Outing Attracts Record Crowd

Under ideal conditions, a record number of members of the Ontario Section of the Canadian Association of Textile Colourists and Chemists met at the Cutten Golf & Country Club, Guelph, Ontario, on June 6th to take part in the Annual Golf Tournament and outing.

For those not interested in playing golf, horseshoe pitching had been arranged by the social committee headed by R B Weatherston, and other members spent the afternoon renewing friendships and relaxing in the brilliant sunshine.

Golf was played by 85 members and visitors, and President A J Tigert welcomed 130 members and guests at the dinners.

Prizes for the days outing were donated by numerous textile manufacturing concerns and allied companies and were presented to the winners by G A Farley.

Among members, J Linton carded low gross in the golf tournament, with J Houlihan second. Low net honors went to W Gudgeon, with H Zimmerman second. H Miller was judged the "best dressed" golfer.

Among visitors, K Taylor and V Hill took first- and second-place honors in low gross, while W Jepsen and G Neckrock were one-two in the low net feature.

J Baily & H Lomas took top honors in horseshoe pitching, with R Howarth & J Mansfield second.

Franklin Process Receives Ad Network Award

Franklin Process Company, Providence, RI, yarn merchants and package dyers, was cited for excellence in advertising at the Annual Creative Awards Dinner of National Advertising Agency Network at the Seignory Club, Montebello, Quebec, on June 2nd.

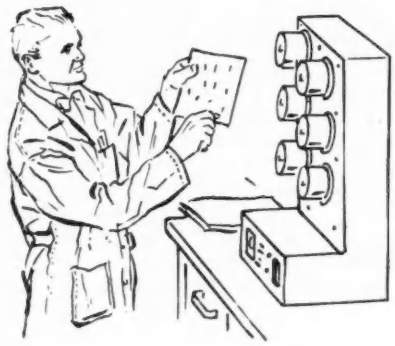
Advertising and promotion of the award-winning company is directed by George T Metcalf Co, Providence, RI. The Metcalf agency is Southern New England member of National Advertising Agency Network, which is comprised of more than forty affiliated agencies in key markets throughout the United States and Canada.

Direct mail promotion of Franklin Process, a division of Indian Head Mills, which was singled out for distinction, is supervised by George T Metcalf, chairman of the board of George T Metcalf Company.

Atlas Random Tumble Pilling Tester
Model PT-6. Other models with four and
two chambers available.

NEW Random Tumble Pilling Tester

...by Atlas



Write for bulletin giving technical details of this new instrument

A New Laboratory Instrument for Evaluating the Pilling and Fuzzing Characteristics of All Types of Fabrics. Will test up to 18 samples per hour.

Results obtained correlate well with actual end use performance in respect to the number, type and size of pills as well as in surface distortion and general overall appearance.

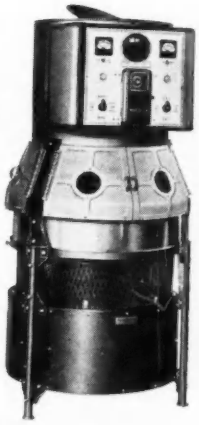
Duration of tests is controlled by an electric timer which may be set to automatically stop the test at any preselected time from one minute to 30 minutes. In action, specimens are constantly flexed and abraded multidirectionally by being rubbed against the neoprene liner as well as against the other fabric specimens.

Specimens are cut 4 3/16 inches square at approximately a 45° bias to warp and filling direction for woven fabrics or to wales and course direction for knitted fabrics.

Each cylindrical chamber is 5.75 inches in diameter by 6 inches deep. Impellers are 4.75 inches long and rotate at 1200 R.P.M. Powered from 115 V. 50 or 60 Cycle A.C. ordinary plug outlet.

FADE-OMETER®

used all over the world as the standard testing machine for determining the action of sunlight on materials.



LAUNDER-OMETER®

Standard testing machine of the A.A.T.C.C. for color-fastness and bleeding, shrinking, resistance to washing, testing dyes, soaps and detergents.

ATLAS ELECTRIC DEVICES CO.

4114 N. Ravenswood Ave., Chicago 13, Ill., U.S.A.

FADE-OMETER® • LAUNDER-OMETER® • WEATHER-OMETER® • ACCELEROTOR® • SCORCH TESTER

Use water in your process?
TERGITOL surface-active agents can help you!

Whether you want wetting action, penetration, dispersion, detergency, or a combination of these properties—there's a TERGITOL surfactant for you. You can choose from nine TERGITOL nonionics.

TERGITOL nonionics are particularly good for emulsifying greasy soils, oils, and waxes—and holding them in stable suspension. TERGITOL nonionics offer you a wide range of solubilities—from complete oil solubility to complete water solubility even at elevated temperatures.

You'll want a copy of the new 40-page booklet covering the properties and uses of TERGITOL surface-active agents. Ask for F-5900. Address Department H, Union Carbide Chemicals Company, Division of Union Carbide Corporation, 30 East 42nd Street, New York 17, N. Y. In Canada: Carbide Chemicals Company, Division of Union Carbide Canada Limited, Montreal.

TERGITOL Nonionics	Cloud Point, °C.	Properties
NP-14	Insol.	Oil-soluble emulsifier and detergent.
NP-27	20	Aromatic-soluble emulsifier and wetting agent.
NPX	60-65	General purpose detergents, wetting agents, and emulsifiers.
TP-9	51-56	
NP-35	90-95	Detergent and wetting agent at elevated temperatures or in presence of dissolved salts.
NP-40	100	Detergent and wetting agent above 100° C.
TMN	35-37	Outstanding nonionic wetting agent with good leveling rewetting properties.
XD	60-65	Outstanding emulsifiers and low-foaming detergents.
XH	90-100	

UNION CARBIDE CHEMICALS

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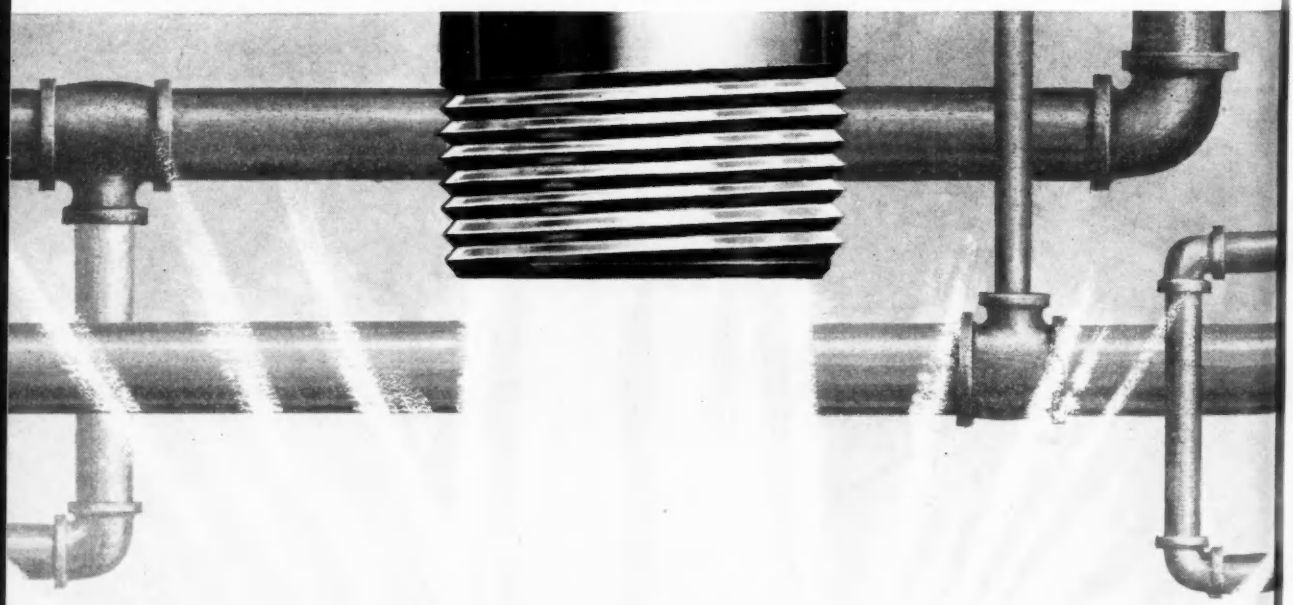


Geigy's New Entomological Labs Completed

New entomological research and chemical analysis laboratories for testing Mitin-mothproofed fabrics have been completed at the year-old headquarters of Geigy Chemical Corporation at Ardsley, NY.

Mills which sign agreements to apply Geigy's Mitin mothproofer to woolen raw stock, yarn or fabric are entitled to free tests of samples of their materials from both of these laboratories. The results of these tests are reported to the mills and dyehouses.

The entomological laboratory infests samples of fabrics with webbing clothes moth and carpet beetle larvae for periods of two weeks to determine that they are impervious to damage from these wool-eating insects. The chemical analysis laboratory tests the samples to determine if sufficient Mitin has actually been applied.

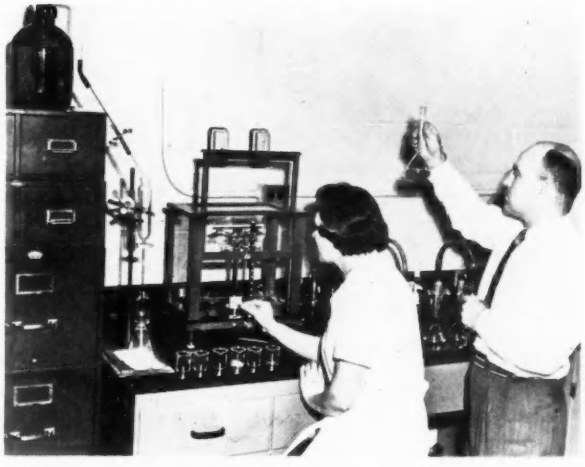
If Geigy's researchers find the application is not what is prescribed, they give counsel to clients offering suggestions as to the steps their technicians should take to obtain the proper results. If called upon, Geigy will send its own technicians to the mill to observe the application procedures, or run an actual application themselves. Geigy's testing procedure, developed over a period of twenty years, is said to be extremely accurate and is depended upon by certain Government agencies which must determine that the goods received are properly mothproofed.

Another service offered Geigy clients is the free examination and testing of fabrics on which complaints have been registered. Geigy has deliberately solicited fabrics and garments that were mothproofed with Mitin and purportedly were damaged by moths in order that a history of performance under conditions of ac-

Donald J Ott, director of research at Geigy Chemical Corp's new entomological laboratory at Ardsley, NY, is shown placing on a balance a swatch glass containing excrement left behind on fabric by beetle larvae to determine its weight, which indicates the amount of damage, if any, to the cloth. The scale on the left is used to weigh swatches of fabrics to be tested, as part of the standard procedure for the fabrics weight loss test for determination of webbing clothes moth damage. The metal boxes contain test fabrics.

Mr Ott checks the progressive destruction of unmothproofed wool fabrics which have been infested with webbing clothes moth larvae. The jar on the extreme right has just been exposed to the larvae, and each jar to the left of it represents an additional week of exposure. The last one shows total destruction after only two months feasting by the keratin-eating insects. Note the regulator and control unit on the upper shelf. Barely visible on the right in front of Ott's jacket is a jar of vitamin-impregnated dog meal, which the insects are fed.

A sample of the colored fluid containing Mitin is placed in a spectrometer, which gives a reading on the density of the color. The reading is then referred to a chart which indicates what percentage of Mitin was in the original fabric sample.



The first step in the chemical analysis of Mitin-mothproofed fabric, to determine what percentage of the compound has been applied, is to measure the weight of a test sample since the prescribed quantity is based on the weight of the fabric. Chemical from the jar on the cabinet is applied to the fabric to draw out the Mitin.

tual use might be built up. It is claimed that no instance of damage by any of the thirteen species of keratin-eating moths or bettle grubs has yet been found on fabrics adequately mothproofed with Mitin. Damage, where it existed, was usually found to have been caused by such things as cigarette or acid burns, animal or nail tears or other causes. This service by a now well-recognized laboratory has simplified for the mills and retailers the handling of nuisance for false claims.

To assure themselves of getting uniform testing facilities, Geigy has bred with a high degree of care a culture of insects that have been selected by entomological authorities as standard test larvae. The insects bred by Geigy have a special diet, and to assure ideal conditions, are raised in a laboratory with a uniform degree of humidity and temperature maintained all year round.

The entomological laboratory, under the supervision and direction of Donald J Ott, was until recently located at Bayonne, NJ. The chemical analysis laboratory, under the supervision of Walter Bill, was formerly at Geigy's office in downtown New York. Both are now in the same section at the Ardsley headquarters.

Union Carbide to Complete Technical Service Lab

Union Carbide Corporation has announced that construction will proceed on the Union Carbide Chemicals Company Technical Service Laboratory originally planned at its Westchester County property at Eastview, near Tarrytown, NY. It is anticipated that construction work will start in August and that the laboratory will be completed and ready for occupancy by late 1959 or early 1960.

In February, Union Carbide Corporation deferred its plans to develop the Westchester site pending further study. Construction of the Technical Service Laboratory was decided upon to expand facilities necessary to broaden the scope of customer service and application research. This is regarded as a vital element of Union Carbide Chemicals Company's present and future marketing program. The status of the other buildings originally planned for the site remains unchanged.

The laboratory will be a three-story building located on the 280-acre tract that Union Carbide bought a few years ago. The main building, with a total floor area of 85,000 square feet, will house 53 individual laboratory units. These facilities will be complemented by a mechanical test building in which pilot plant operations will be conducted and special materials testing studies will be made.

The laboratory will also include a 200-seat auditorium which will be used to hold seminars and other technical meetings. It is anticipated that the technical service headquarters will also serve as a training center for Carbide technical sales representatives.

The laboratory will both expand and centralize the facilities of Union Carbide Chemicals Company for the development of technical information and to conduct application research on new products. At present, much of this research is carried on by Union Carbide Chemicals at South Charleston, W Va, and at various other chemical plant locations.

General Latex Plans North Carolina Plant

General Latex & Chemical Corp, Cambridge, Mass, has begun negotiations for the construction of a new plant in Charlotte, NC.

The proposed plant, which will serve the textile industry in the tri-state area of North Carolina, South Carolina and Virginia, will be a fully integrated operation complete with sales office, laboratory and compounding facilities.

The proposed site will bring the number of General Latex plants in the US and Canada to six. The company at present has plants at Cambridge, Mass; Dalton, Ga; Ashland, O; Verdun, Montreal, PQ; and Brampton, Ontario.

General Latex custom-compounds latices and imports natural latex produced by Harrison's & Crosfield, (Malaya) Ltd. The company also acts as US representative for Pliolite latices produced by the Goodyear Tire and Rubber Co, Chemical Division, Akron, O.

PTI, PTIF Corporations Elect

Bertrand W Hayward was re-elected head of the Philadelphia Textile Institute at the annual meeting of the PTI corporation and its trustees last month. **Everett L Kent**, Kent Mfg Co, was re-elected president of the PTI Foundation, which also held its annual metting in June.

At the PTI trustees' meeting, the following officers were elected for the coming year: **W Lyle Holmes Jr**, Archibald Holmes & Sons, chairman; Dr Hayward, president; **Ralph Whitaker**, Fred Whitaker Co, 1st vice president; **C Scott Althouse**, Althouse Chemical Co, 2nd vice president; **Julius Zieget**, PTI staff, secretary and treasurer; **Thomas Hyndman**, solicitor.

At the Foundation's trustees meeting, other officers elected in addition to Mr Kent were: **Theodore B Hayward**, 1st vice president; **Lindsey H Mason**, Philadelphia Dye Works, 2nd vice president; **Richard S Cox**, PTI dean emeritus, treasurer and executive secretary; and **Russell C Osborne**, secretary. **Alan M Richter** was reappointed director of public relations.

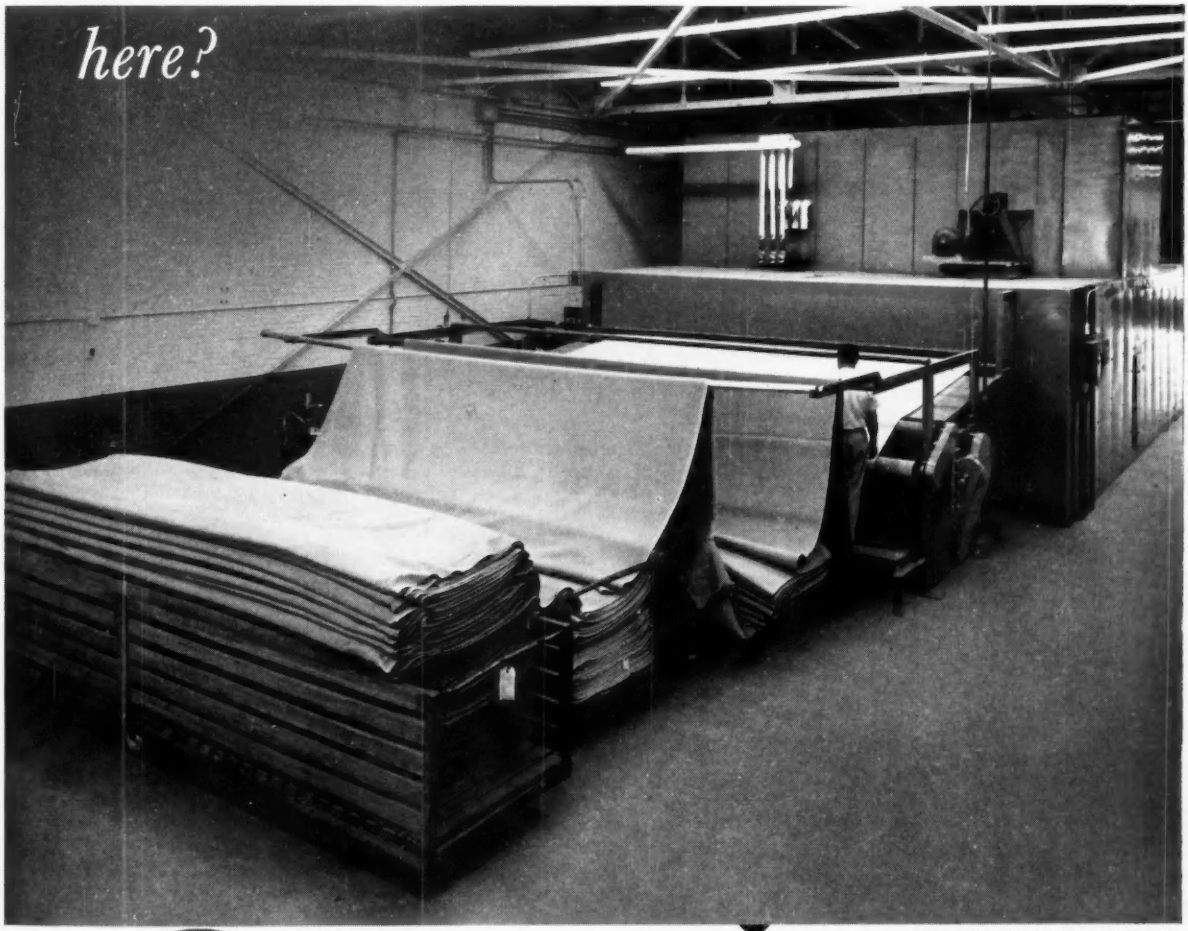
Wash and wear treatments or cotton fabrics were the chief topic of discussion when two research leaders for Ciba, Ltd, came to the New Orleans laboratory of the Southern Utilization Research and Development Division. They were S N Glarum, of Ciba Co, Inc, New York, and Anton Schurch, of the Ciba establishment in Switzerland. They described the accomplishments of Ciba in research on this project, and learned about the SURDD process for application of a wash and wear treatment to the completed garment. The process is designed to assure neat seams and permanently placed creases where these are desirable. Pictured are, standing, J David Reid, head of chemical finishing investigations at SURDD, and seated, left to right, Dr Glarum and Dr Schurch. The Southern Division is the center of cotton utilization research for the Agricultural Research Service, USDA.

A custom-blended carpet backing by General Latex — that is what's going on here.

what's going on *here?*

And for this tufted carpeting manufacturer, it's like rolling on profit by the yard. Because this special fast curing compound locks loops tight; adds dimensional stability . . . is odor-free . . . lends durability . . . provides just the right "hand" . . . gives highly saleable extra quality at minimum cost.

There's a custom-blended General Latex compound that can put an end to your carpet or rug backing problems. And to serve you better and faster, there's a General Latex plant in Dalton, Georgia, in the heart of the tufted industry.



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GENERAL LATEX AND CHEMICAL CORPORATION

. . . 666 Main Street, Cambridge 39, Mass.

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General Latex and Chemical Corporation (of Ga.) 1206 Lamar Street, Dalton, Georgia
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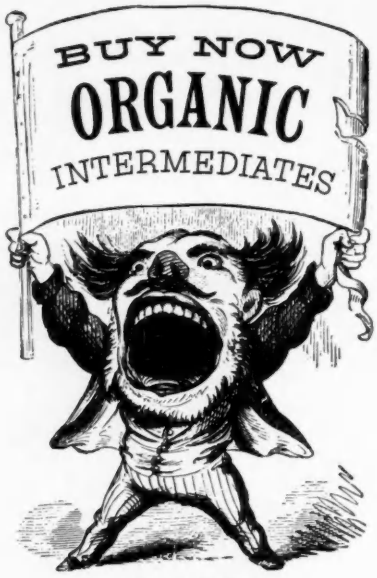
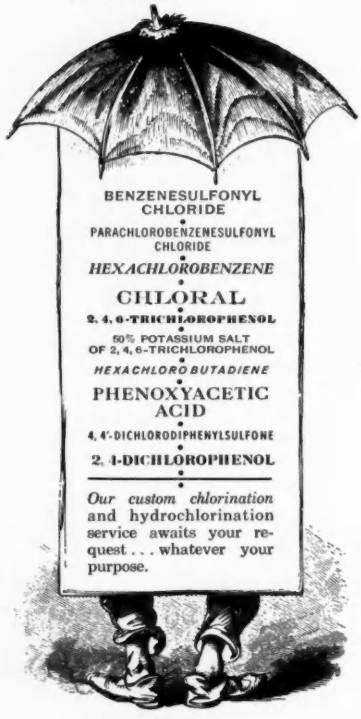
VULTEX

representatives in principal cities — exclusive agents for sale in U. S. A. of Harrison & Crosfield Malayan Latex — sales agent in U. S. A. for Goodyear's PLIOLITE Latices



Hear Ye! Hear Ye! These ten organic intermediates are now available to you . . . twice as many as before! All of excellent quality . . . amply available . . . promptly shipped.

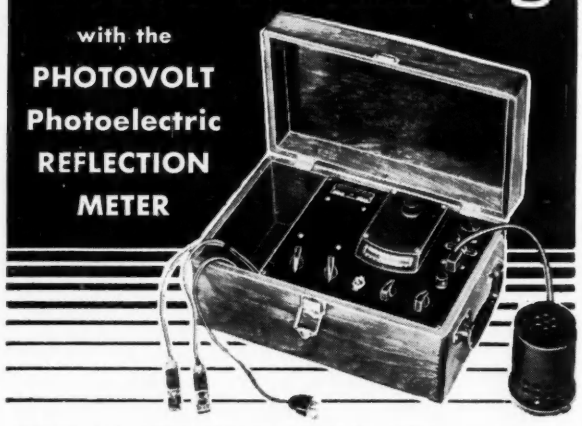


Diamond Chemicals

DIAMOND ALKALI COMPANY
Union Commerce Building
Cleveland 14, Ohio

Color Matching

with the
PHOTOVOLT Photoelectric REFLECTION METER



A truly practical precision instrument for color matching and for specifying color by tristimulus values, also for fading and detergency tests . . . for production control and laboratory work.

Portable, sturdy, simple to operate

Also: Colorimeters, Fluorescence Meters, pH Meters

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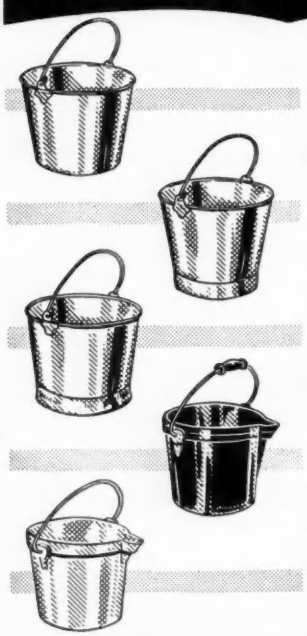
CORROSIVE RESISTANT PAILS



STAINLESS STEEL. Heavy gauge and seamless, with extra thick rims and bottoms, these pails can take rough handling without life-shortening effects. Plain or chime bottom. Sizes: 13, 16, and 20 quart.

TYPE 316 STAINLESS. For extra corrosion resistance with acids and other corrosive chemicals, Type 316 Stainless pails should be used. Plain and chime bottom. Sizes: 13, 16, and 20 quart.

MONEL. These welded Monel pails remain virtually unaffected by the corrosive attack of brine, most types of volatile fluids, acids and alkalies. Sizes: 12, 14, 16, and 20 quart.

HARD RUBBER. Made with a virgin rubber base, this pail will not crack or chip; it resists abrasion, heat distortion, and the corrosive action of a wide variety of chemicals. Capacity, 3 gallons, graduated 1 to 12 quarts.

POLYETHYLENE. Unbreakable and quite chemically inert, this pail is molded in one piece, with bale handle and broad pour spout for easy pouring. Extra heavy construction. 2½ gallon capacity only.

READING SCIENTIFIC COMPANY
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• NAMES IN THE NEWS •

Endler

Apex Chemical Co, Inc, Elizabethport, NJ, has engaged the services of **A S Endler** as a member of its research and development staff. Dr Endler was formerly associated with Hart Products Corp and DePaul Chemical Company.

Bener

Christian Bener, internationally famous textile chemist of Chur, Switzerland, celebrated his 60th birthday this past June 24th. Dr Bener was one of the original investigators of permanent finishes on textiles and has many patents to his credit in several countries. Among his U S patents are those on nonshrink effects on cellulosic fibers, permanent fixation of mechanical deformations on cellulosic fibers, partial mechanical deformation on a cellulosic fiber patterned effect, transparent imitation, permanent crush- and shrinkproof finish, and crepe effects.

Dr Bener was born in Chur where his family was active in textile finishing for well over 250 years. He received his degree as a chemical engineer at the Federal Polytechnikum in Zurich and his doctor's degree at the University of Lausanne in 1924. After his graduation, he worked in a patent office and from 1929 to 1940 he worked with textile finishers and dyestuff manufacturers in Switzerland. In 1940 Dr Bener established a patent information service in Chur which he still operates and he has many clients throughout the world. He has been active in the reorganization of the textile division of the Swiss patent office.

Harry B McClure, vice president of Union Carbide Corp, was elected chairman of the board of directors of the Manufacturing Chemists' Association at its 86th Annual Meeting last month.

He succeeds **Ernest Hart,** president of Food Machinery and Chemical Corp.

John T Connor, president of Merck & Co, Inc, succeeds Mr McClure as chairman of the executive committee.

Gen John E Hull, USA (Ret), full-time president and a director, was re-elected.

Re-elected vice president was **D S Frederick,** vice president of Rohm & Haas Co. **Fred C Foy,** president, Koppers Co, Inc, was elected an MCA vice president.

M F Crass Jr, full-time secretary-treasurer, was re-elected.

Eugene J Sullivan, who started as a Borden glue salesman twelve years ago, became executive vice president of the Borden Chemical Co on July 1.

Mr Sullivan, vice president in charge of sales of Borden Chemical Co since Jan 1, 1957, succeeds **H H Clarke Jr,** who recently left the Borden Chemical Company to become president of Dyna-Therm Chemical Corp, Culver City, Calif.

William E Hanford, vice president for research & development, Olin Mathieson Chemical Corp, is the newly elected Honorary Chairman of the American Section, Society of Chemical Industry, for the year 1958-1959. Announcement of the election was made by the Section's retiring chairman, **William H Bowman,** American Cyanamid Co.

Wallerstein Co, Inc has named **James Casserly** sales manager of its Textile Division, and **Edward Rollhaus** chairman of its Commercial Development Group.

Mr Casserly will assume duties formerly handled by **J Andrew Clark,** who has become technical director of the Division. Mr Clark, in his new capacity, will act as technical advisor to the trade and as director of market and technical research in matters pertaining to the textile industry. Mr Casserly, during the past nine years, has represented Wallerstein in the field, covering the Eastern territory from Canada to North Carolina.

Serving with Mr Rollhaus on the Commercial Development Group are **Kenneth Howard** and **James Boyd.**

Hunter

Minor Hunter, a technician specializing in textile printing and chemical sales throughout the Southern states, has joined the Charlotte office of Sandoz, Inc. Mr Hunter will be active in sales work and technical service in connection with Sandoz chemicals.

Cain

Alco Oil & Chemical Corp, Philadelphia, has named **C Eugene Cain** asistant technical director.

Mr Cain joined Alco in 1952 to become head of the sales service laboratories and held this position until transferred to the planning and engineering group in January, 1957.

Tennessee Corp has appointed **Edwin J Seiferle** director of market research and appraisal, and **William C Duckworth** market development specialist for organic chemical intermediates in its Market Research and Development Department.

Dr Seiferle, who was formerly senior development engineer in the General Development Dept of Hooker Chemical Corp at Niagara Falls, NY, will be responsible for market research services and for new product and new project appraisals.

Mr Duckworth, who was formerly director of organic research for the corporation, will be responsible for the commercialization of organic chemicals developed in the company's Research Laboratories in College Park, Ga.

Both men will be located at 1330 West Peachtree, Suite 500, Atlanta 9, Ga.

Daniel B Witwer has been elected vice president of Polyvinyl Chemicals, Inc, Peabody, Mass, manufacturers of acrylic, vinyl acetate, and styrene polymer emulsions. Mr Witwer's responsibilities will center in the company's sales, research and manufacturing activities.

Mr Witwer formerly was Manager of the Acetylene Chemicals Department, General Aniline & Film Corp.

Horace K MacKechnie has been named technical director of the electronics section of the Lowell Technological Institute Research Foundation. Mr MacKechnie, who assumed his position June 1, will have charge of securing contracts, handling customer relations, and directing project work in electronics, electronic controls for industry, and automation. He comes to the LTI Research Foundation from Technical Design & Development Co, Inc where he was head of the Boston Division as engineering manager.

Food Machinery and Chemical Corp has announced the following new apointments in its Chemical Divisions:

Hans O Kauffman, formerly technical director of FMC's Becco Chemical Div, has been named director of research and development for the Inorganic Chemicals Dept, where he will be responsible for research and development activities of Becco Chemical Div, Westvaco Chlor-Alkali Div, and Westvaco Mineral Products Div.

Oscar H Johnson, formerly director of research for Niagara Chemical Div, is now director of research and development for the Organic Chemicals Dept. He will direct the basic organic research programs for this newly formed Department, which comprises Niagara Chemicals & Plastics Div, at the FMC Central Research Laboratory. He will also work closely with the Divisional research programs at Baltimore, Md, and Middleport, NY.

William A Kebba has been named manager of planning and control for the Inorganic Chemicals Dept, and **Robert H Malott**, manager of planning and control for the Organic Chemicals Dept. Mr Kebba has been with FMC since 1954 in the Controller's Department of the Chemical Divisions Administrative staff. Mr Malott has served FMC as assistant to its Chemical Divisions executive vice president and most recently as controller of its Niagara Div. He will continue to hold the latter position.

Kraft

Kindron

Francis A Kraft has been promoted to assistant manager of the New York-Philadelphia sales territory of FMC's Becco Chemical Div, where he has served since 1957. His headquarters will be Becco's New York office.

Robert R Kindron has been named technical assistant to Becco's New England sales manager. He will work out of Becco's New England office in Framingham, Mass.

Alfred E Brown, Harris Research Laboratories, Inc, presented a paper entitled "The Supercontraction of Keratin Fibers by Lithium Bromide" at a Symposium on Sulfur in Proteins which was held at Falmouth, Mass, on May 22-25. The Symposium, attended by 50 scientists, was organized by **Reinhold Benesch**, of the Marine Biological Laboratory, Woods Hole, Mass. Other specialists in the keratin field who were present were **Drs Swan, Lindley** and **Gillespie**, of the Wool Textile Research Laboratories, CSIRO in Australia, and **Milton Harris**.

OBITUARY

WILLIAM H BRINKLEY

William H Brinkley, Southern Division sales manager for E F Houghton & Co, died suddenly in Greensboro, N C on May 24. He is survived by his wife, Lucretia.

An employee of Houghton since 1925, Mr Brinkley served as sales manager of the company's Western Division prior to moving to the Southern post in 1934, with headquarters in Charlotte.

MARGARET H BARNETT

Margaret H Barnett, who held the title as the only woman group leader at the Chemstrand Corporation's Research and Development Center at Decatur, Ala, died May 23 following a brief illness. She was 31.

Miss Barnett was a textile chemist in Chemstrand's dyeing and finishing department. She had advanced to the position of group leader in a research field usually considered a "man's world."

Prior to joining Chemstrand in 1953, she had worked with Callaway Mills, La Grange, Ga, and as a graduate research assistant at Florida State University, her alma mater.

Leslie B Coombs, president of Bradford Durfee College of Technology, Fall River, Mass, retired June 30, 1958 after having served the College as head of the Department of Chemistry and later as its president for a period of twenty-four years. **William J Holland** (Harvard '32) will succeed him. Mr Holland was formerly with the Union Carbide Corporation, Oak Ridge, Tenn.

Nopco Chemical Company, has announced the recipient of the Charles P Gulick Scholarship for 1958. Winner of the scholarship is **Amy Louise Whitton**, of Cedartown, Ga. Miss Whitton is the daughter of **Dewey D Whitton**, a machinist employed at Nopco's Cedartown plant.

The official presentation of the award to Miss Whitton was made recently at Nopco's plant in Cedartown by **Harry A Batley**, vice president of Nopco. Also present for the occasion were the scholar's father and **R Lamar Jones**, Cedartown plant manager.

Miss Whitton is a graduate of Cedartown High School. Her educational plans call for majoring in business administration with a possible future career in teaching.

Miss Whitton is the third person to receive the scholarship, as it was established by the board of directors of Nopco in March 1956 to honor the memory of Charles P Gulick, the founder of the company, who passed away in 1955. Having a value of $750 per year for four years at the college of the recipient's choice, the scholarship is awarded annually to a son or daughter of a Nopco employee. Candidates are judged by a scholarship committee on the basis of scholastic achievement, financial need, character, and well-rounded personality.

Joshua E Murrow Jr has joined the Synthetic Fibers Group, Research Department of Union Carbide Chemicals Co, Division of Union Carbide Corp.

Mr Murrow will work on applications of new experimental fibers for the textile industry. Previously, he was associated with the Luxite Division of Julius Kayser & Co, Haleyville, Ala, where he was engaged in the knitting, dyeing, finishing and cutting of tricot fabrics.

The transfer of three technical representatives was recently announced by Union Carbide Chemicals Co as follows: **Paul A Hiznay** to the Philadelphia District; **Francis R Kean** to the Newark District; and **Charles D Schmidt** to the Detroit District.